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TABLE OF CONTENTS.

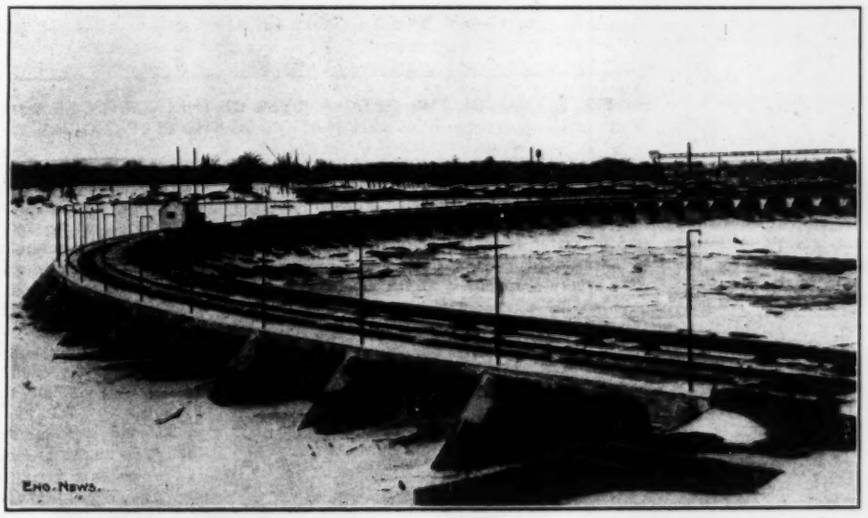
LEADING ARTICLES:	Page.
The Chaudiere Dam, Ottawa, Canada (illustrated); Douglas L. McLean	741
The Block Signal Question; James Brandt Latimer	743
Septic Tank and Contact Beds for Treating the Sewage of Cherryvale, Kan. (illustrated); J. S. Worley, Assoc. M. Am. Soc. C. E.	746
An Experiment to Determine the Pressure of Concrete upon Forms (illustrated); L. E. Ashley	748
A Comparison of the Horse and the Gas Traction Engine; L. W. Ellis	748
A Polar Planimeter for Averaging the Records of Circular Instrument Charts (illustrated)	749
The Growth of Electricity Supply Works in the Years from 1902 to 1907	749
Pitot Tube Steam Flow Meters (illustrated)	750
The Library of the New York Public Service Commission, First District; Robert H. Whitten	750
Reconstructing a Defective Bridge under Traffic (illustrated)	752
A 30-Year Record of Flow for the Columbia River	752
The Construction of Sand-Clay Roads in Western Kansas; W. S. Gearhart	753
Annual Convention of the American Society of Civil Engineers	754
Annual Convention of the American Railway Master Mechanics' Association	755
Tests of Oil Fuel at Panama	756
Statistics of Locomotive Boiler Explosions on American Railways	761
A Report on the Licensing of Civil Engineers	761
The Need of Collective Effort by Engineers; John A. Bensel, President Am. Soc. C. E.	762
Work of the Smoke Inspection Bureau of Milwaukee, Wis	762
EDITORIAL	757
Human Limitations in Construction Work—Libraries of Industrial Corporations and Public-Service Commissions—Simplicity in Railway Signaling—Sand Roads and Clay Roads in Rural Districts—Depreciation as an Element in Water-Works Valuations for Rate-Fixing Purposes.	
The Engineering Society as a Molder of Legislation	758
LETTERS TO THE EDITOR	759
"Hay Steel" in the Plattsmouth Bridge; C. H. Cartlidge—The Use of Bitumen as Fuel; C. P. Bowie, Assoc. M. Am. Soc. C. E.—Formulas for Determining Street Crowns When the Two Curbs Are at Different Elevations (illustrated); Hazlehurst & Anderson—What Stream Gagings Indicate as to the Run-Off from Forested and Barren Areas; Farley Gannett—Notes and Queries.	
ENGINEERING NEWS OF THE WEEK	763
PERSONALS	764
ENGINEERING SOCIETIES	764

The Chaudiere Dam, Ottawa, Canada.

By DOUGLAS L. McLEAN.*

The Chaudiere Dam, situated on the Ottawa River, just above the crest of the Chaudiere Falls, between the cities of Ottawa and Hull, Canada, was built in 1908-09 by the power owners and lessees of those falls and is an interesting type of stop-log dam. It is of steel and concrete construction and of the pier-and-sluice type. The sluice openings are provided with stop-logs, which are moved by a powerful electric winch traveling on rails on the bridge floor of the dam.

The unique conditions which this dam fulfils may be summarized as follows: (a) Its construction makes binding an agreement between the power owners that settled a number of pending lawsuits. (b) It has to divide the flow as equally as possible between the Ontario and Quebec sides of the river. (c) It has to allow the spring floods to pass without appreciable back-water effects. (d) It has to be capable of holding the water to a certain desired elevation. This regulation has to be carried on, at times, under the severe climatic conditions of a Canadian winter. (e) It has to be strong enough to withstand the log-jams or ice-shoves that may come against it.



THE CHAUDIERE FALLS STOP-LOG DAM IN THE OTTAWA RIVER, NEAR OTTAWA, CANADA.

(Photograph taken in January, 1910.)

The Ottawa River, which helped to impose a number of the above conditions, is the main tributary of the St. Lawrence River. A map of the river in the immediate vicinity of the dam is shown in Fig. 2. Above the Chaudiere Falls, it has a drainage area of 34,623 square miles, and a length of over 450 miles. The mean yearly precipitation (average for 38 years) was 31.6 ins. The run-off (average for 38 years) was 53% of the precipitation. The maximum discharge at the falls was 193,000 cu. ft. per sec. in 1876. The minimum discharge was 11,000 cu. ft. per sec. in 1906. The yearly mean run-off for the year of average discharge, 1860, was 46,000 cu. ft., per sec. The available storage, above the falls, is 14,500 square-mile-feet. This storage will increase the minimum flow to 28,000 cu. ft. per sec. The temperature for the months of December, January, and February averages often 12° F. which gives the river a 2-ft. ice sheet.

*Ottawa, Ont.

Type of Dam.

To determine the type of dam and system of regulation best suited to meet the various conditions, a commission, consisting of Wm. Kennedy, Jr., and J. B. McRae, Engineers, and Geo. H. Millen, and Wm. Baldwin, Superintendents, from two Chaudiere power plants, visited the leading power sites and dams in Minnesota and Michigan. They also consulted engineers and other officials in charge of the maintenance and operation of these works. Bear-trap dams, Tainter and Stoney gates were found to be unsuited to the Chaudiere conditions, even without considering the question of cost of construction. A pier-and-sluice dam with stop-log regulation was unanimously decided upon as being more workable under the climatic and other conditions of the Ottawa River than any other design or construction of which the commission had knowledge.

A good idea of this style of dam as finally built may be gained from the view on this page showing the completed dam as it appeared in Jan., 1910. This shows the circular-shaped dam with its 49 piers and two abutments laid out radially to the arc of a circle of radius 566.33 ft., from pierhead center to center of arc. The length of this arc is 1,300.189 ft.

With a maximum flood of 193,000 cu. ft. per sec., 50 openings, each 22 ft. wide, with 17.5 ft. depth of water, give an area of 19,250 sq. ft., which gives an average velocity of some 10 ft. per sec. through the sluice openings.

BACK WATER EFFECT.—Such a flood as this which was practically equalled by the high water of May, 1909 (see Fig. 3), would have very little back water effect. This, no doubt, is due to the increased discharge way afforded by the circular shape and is also due to the shape of pier used.

As data on the back water effect of dams is scarce and of value in lawsuits arising from flooding, the following elevations taken by Newton J. Ker, City Engineer, Ottawa; R. W. Farley, City Engineer, Hull, and S. J. Chapleau, Engineer, Department of Public Works, Ottawa, during high water, June 2, 1909, will prove of interest:

	City datum.
60 ft. upstream from the dam, water level	53.65
34 ft. upstream from the dam, water level	53.65
25 ft. downstream below the dam, water level	53.63
99 ft. downstream below the dam, water level	53.52

which shows very little difference 30 or 40 ft. on either side of the dam.

Piers.

The governing elevations of the dam which are all referred to Ottawa City datum (see Fig. 4) are as follows:

Stop-log sill	Elev. 37.00
Crest of old dam	Elev. 45.50
Beginning of 45° batter on pier nose	Elev. 46.00
Present water level, January, 1910	Elev. 48.00
Proposed raised water level	Elev. 52.00
High water of 1909	Elev. 54.40
Bridge floor elevation	Elev. 59.00

The piers, the most important feature of the whole structure, are 39 ft. 5 ins. long at the base and are battered to give a length of 23 ft. 5½ ins. to the bridge-floor support at Elevation 57.75. They have a clear height from stop-log sill to bridge-floor of 22.00 ft. Their cross sections at base are modified ellipses, as the ellipse affords the least obstruction to flowing water. To prevent the debris which might pass the noses of two adjacent piers from wedging between their downstream ends, owing to the convergence given by their radial setting, the piers are made 4 ft. wide at the nose or upstream end and tapered to 2 ft. at the tail or downstream end. This gives, between piers, 22 ft. of clear sluiceway at the upstream entrance and 22 ft. 5¾ ins. at the downstream exit.

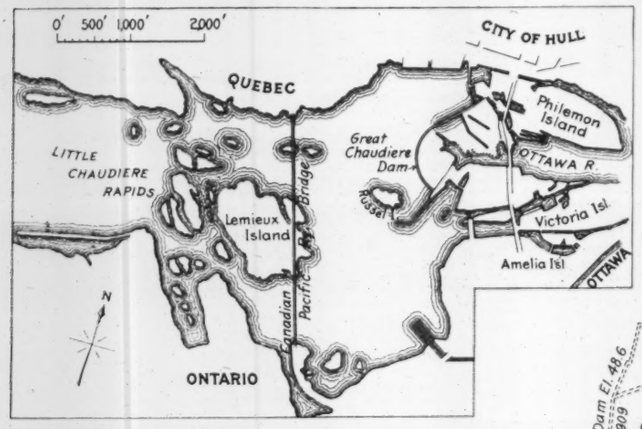
In designing the piers, water at an elevation of 52.00 and causing a pressure of 100 tons acting at elevation 42.00 was used in conjunction with an ice pressure of 200 tons acting at elevation 52.00. To counterbalance the effect of this turning moment, an anchorage of rock bolts (see Fig. 5) capable of developing a stress of 200 tons, was placed in the front section. The resultant stress

acting 10 ft. in front of the stop-log post, combined with the weight of the pier acting through its center of gravity and the ice and water pressure, brought the final resultant well within the middle third. The chief function of the rear anchor bolts is to resist shear.

These piers are founded on the solid Trenton bed-rock. Where fissures or cracks occurred a cut-off trench of 1:3:6 concrete was put in. This same mixture (1:3:6) was used in the foundations. Above elevation 37.00 in the piers and bridge-floor, 1:2:4 concrete was the order. Round anchors, 1¾ in. diameter and 4 ft. long (21 to the pier) were securely grouted into holes in the solid rock. These came up in pairs, having their upper ends secured by nuts and washers, over two 5-in., 6½-lb. channels, which rested on four 4-in., 5¼-ft. channels, two on each side of the pier, as shown in Fig. 5. The 4-in. channels were placed with lower flanges at elevation 35.50 and extend the whole length of the pier.

A space between each pair of channels allows the vertical reinforcement to pass through and up from the under side, where the upset ends of the rods are securely held by nuts and washers to the channels with center 6 ins. from outside of piers, to beneath the nosing plate and bridge-floor, where the rods are bent in a semi-circle like hairpins and come down to be secured underneath the pair of channels on the opposite side of the pier. In the upstream portion, or that above the stop-log posts, the vertical rods are 1¼-in. round spaced 6 ins. between centers, while below the posts, or downstream, they are ¾-in. rounds at 9-in. centers. Running outside of these upright rods are ⅜-in. horizontal round rods, spaced on 16-in. centers and wired to the vertical members. There are also nine ¾-in. rods in the rounded ends of the nose which are bent up parallel to the batter; a like number of ¾-in. rods are used in the downstream ends. These rods were set in the foundation matrix and not connected with the system of anchors. Above elevation 46.00, ⅞-in. rods 21 ft. long were put in horizontally in sets of three to bind the upstream and downstream portions together. The reinforcement for the piers is shown in Fig. 6. With the 1:2:4 concrete surrounding the steel reinforcement, the pier became a permanent structure securely bound to the solid bed-rock on which it rested.

To protect the concrete on the face of the upstream batter from the pounding of ice or logs, ½-in. rounded nose-plates, 11 ft. 7½ ins. long were securely anchored to the concrete backing. A double system of stop-log checks was thought advisable. The stop-log post for this purpose is composed of eight 12-in., 25-lb. channels, eight 3 × 2½ × 7/16-in. angles with ½-in. plates and anchors. The total weight of each pier post is 9,517 lbs. The sills are two 15-in., 33-lb. channels and were placed at elevation 37.00. They were solidly bedded by forcing 1:2 mortar through 1½-in. holes in the upper surface of the channels and were anchored by 1¾-in. bolts.



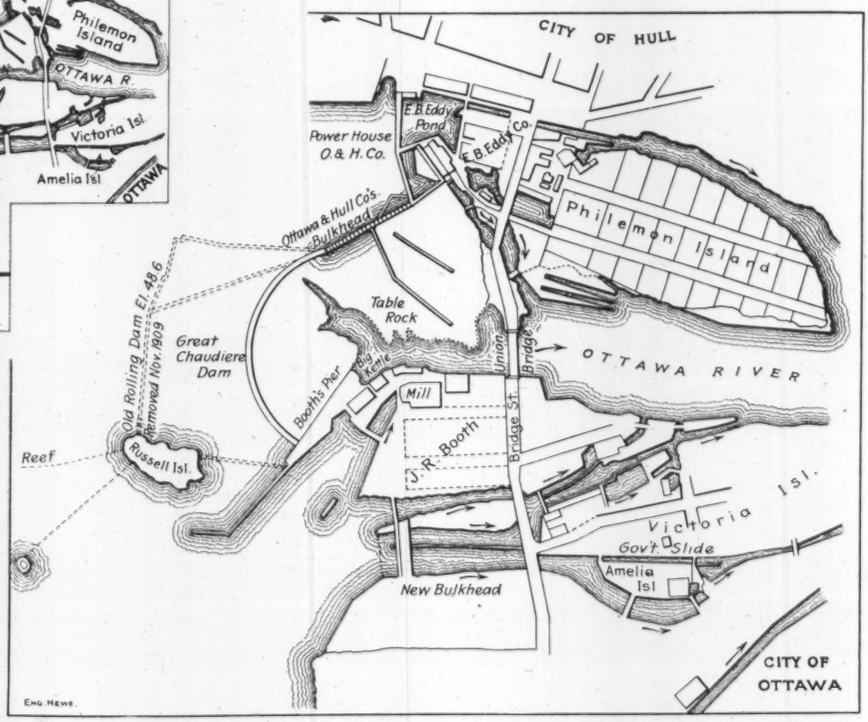


FIG. 2. MAP OF THE OTTAWA RIVER IN THE VICINITY OF CHAUDIERE FALLS, SHOWING THE LOCATION OF THE STOP-LOG DAM.

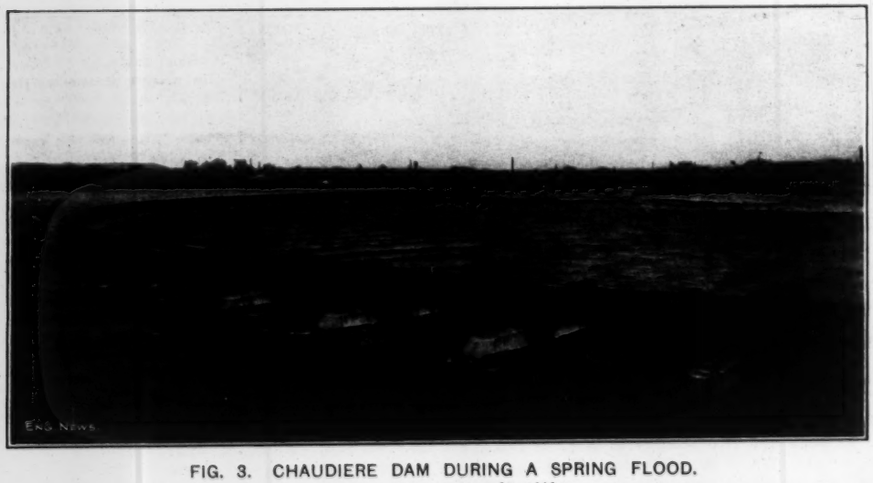


FIG. 3. CHAUDIERE DAM DURING A SPRING FLOOD.
(Photograph taken May 25, 1909.)

Bridge-Floor.

An additional rigidity is imparted by the reinforced-concrete bridge-floor, which unites the tops of the piers. This floor is 23 ft. 5½ ins. wide and 15 ins. deep. It is reinforced by ¾-in. straight round rods at 6-in. centers on the bottom and by ½-in round rods on the top at 6-in. centers. The web reinforcement consisted of ¼-in. U-stirrups wired to tension members, and ¼-in. rods at 14-in. centers run at right angles to the main reinforcing in the top and bottom of slab.

The floor is divided into two parts by the 4-ft. 5-in. stop-log opening. This opening is divided in the center by two 12-in., 20½-lb. channels separated by bolts and piping. This leaves 19 ins. clear for each stop-log way. Protection to the edge of slab at these openings is given by a 3 × 3 × 7/16-in. angle and 12-in. channels at 20.5 lbs. were anchored to the concrete backing. The angles are so placed as to form checks for a wooden covering of the opening, if such be desired. The upstream portion of the floor carries the winch rail, poles for winch trolley wire, etc., while the downstream carried the other winch rail and two skids at 16-ft. centers, which support the stop-logs when not in use. The winch rails consist of a ⅞-in. bar on upstream and a ¾-in. bar on downstream beam, curved to a proper radius and riveted to the supporting 7⅞-in. × 7⅞-in. H beams. The top flooring consists of 1 in. of 1:2 mortar. Expansion joints of tar-paper, lead and asphalt were laid every fifth pier.

Stop Logs and Winch.

The stop-logs, which close the sluice openings, are of British Columbia Douglas fir. They are 23 ft. 10 ins. long and of three sizes, viz., 18 × 16 ins., 16 × 16 ins. and 14 × 16 ins. With the exception of the two top logs of an opening set, the logs were made up as double stop-logs. To effect this, each pair of logs was bolted together by eight ⅞-in. bolts. This made a single unit of the two sticks and meant a considerable saving in handling. (See Fig. 7.) The number ordered for the dam was:

200—18 × 16-in. logs.
200—16 × 16-in. logs.
150—14 × 16-in. logs.

The details of the stop-log ends are shown in Figs. 7, 8 and 9.

The stop-log winch or the machine for handling these massive logs consists essentially of two long powerful rams or arms mounted, with suitable driving gears and shafts, on a heavy steel frame supported by two trucks. At the end of each ram is a hook, as shown in Fig. 10, which can be secured in the recesses at the end of the stop-log. Opposite each stop-log post are two heavy anchors firmly secured in the concrete structure. To these the frame of the winch is secured by hooks. This anchorage enables the rams not only to lift the stop-logs but also to force them down in the checks and ensure a tight fit between logs, thus saving leakage. Clutches enable the rams to be operated singly or together. A side-travel of 32 ins. is provided on the trucks, to enable the machine to serve both stop-log checks. The winch is designed to exert a maximum lift of 35 tons. The maximum speed for racks on rams is 29.6 ft. per min.; maximum speed of winch on rails, 189 ft. The winch travels on the rails 0.97-ft. per revolution of the crank; travel of ram, 0.285-in. per revolution of shaft. All gears are made of cast steel with dressed teeth, but the rack which is also of cast steel has rough teeth. The rack pinion is made of forged steel and its teeth are dressed.

The winch is shown in operation in Fig. 11. Power is supplied by a 50-HP., D. C., motor, operated at 600 volts. If this fails, hand power may be used with the handicap of slower handling of the logs. The motor is provided with a rheostat controller. The cabin on top protects the operator of the motor, clutches and brake from bad weather. There is a bell in it, with cord outside to enable the men handling the stop-logs to signal the operator of the winch.

A house on a separate truck is attached to the winch and protects the 5-HP. boiler used for thawing out the checks and the ram-hook recesses in the stop-logs. The ice sheet of the river is kept clear of the logs by keeping a foot width upstream chopped clear.

With this outfit no difficulty has been found in handling the logs in the severest zero weather. To further facilitate their handling, two crane beams with trolleys, blocks and tackle will be added to the downstream side of the winch. They will assist in placing the stop-logs on the skids.

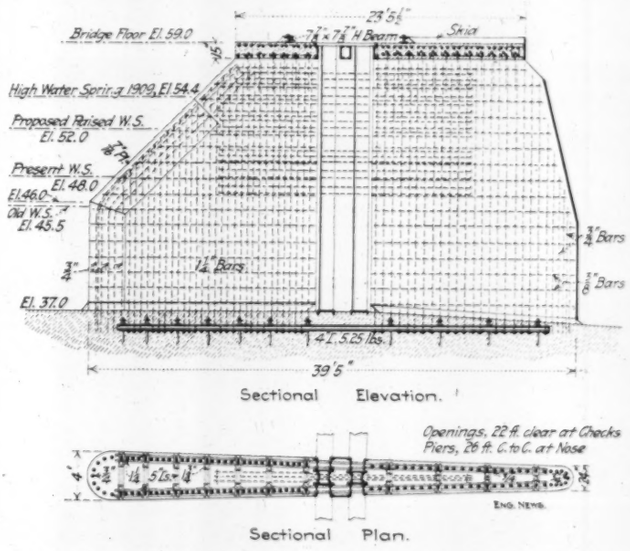


FIG. 4. PLAN AND ELEVATION OF ONE OF THE 49 REINFORCED-CONCRETE PIERS OF THE CHAUDIERE DAM.

The Block Signal Question.

By JAMES BRANDT LATIMER.*

The United States Government is predicated on the assumption that the people form the Government, and for the past 135 years we have been educating our schoolboys and foreigners who have made their homes with us to believe that the wishes of the people embody more wisdom than can possibly be gotten from the minds of the President, Cabinet, both houses of Congress, and the Supreme Court. From feeling perfectly capable to run the business of the United States Government, the average citizen has grown into the belief that he is as well (and frequently more) able to run any other citizen's private business than that citizen may be himself. This is particularly noticeable with regard to our railroads: partly, no doubt, because they are a quasi-public business; and partly because so much of their property lies out of doors, and so much of their operation is in plain sight of everyone, that it attracts more general attention than is the case with any other business.

The Popular Demand for Block Signals.

That the public has a perfect right to demand certain results of the railroads no sane person will attempt to deny. But just how far the public has a right to go in specifying the ways and means by which such results may be obtained is another question, and one which the Courts may some day be called on to decide.

Safety of railroad operation is without doubt within the public's right to demand. A series of disastrous collisions which took place a few years ago, entailing appalling loss of life, roused the public to insist that the railroads should give more heed to this side of the operating question than many of them had apparently given up to that time. This was all perfectly proper and right, but during the last five years a good deal of legislation has been suggested and urged, laying down hard and fast rules by which such results must be obtained.

One idea that has thoroughly fastened itself in the public mind is that the use of block signals is the only sure way of improving existing conditions, and a good deal has been said and written about the absolute collapse of the train dispatching system, which until a comparatively recent date had been the standard method of moving trains in the United States.

Far be it from me to defend the train dispatching system as such against a good block system, but the devil is not always as black as he is painted, and the train dispatching system is not entirely without some redeeming features. As I shall point out farther on there are certain conditions under which trains may be moved with greater safety by it than by block signals.

No doubt a day will come when train dispatching will disappear in this country and we will move trains as is done in Europe, entirely by block signals. But this cannot be done as long as so large a proportion of our mileage is single-track, and the volume of business fluctuates as it now does, necessitating the running of numerous "extras." These two conditions alone will perforce keep the dispatching system alive, because meeting and passing points must be arranged for at all sorts of irregular times and places which nothing but the mind of a trained dispatcher can foresee. The dispatching system will surely outlive the present generation; so we had best reconcile ourselves to the fact that it is a necessary evil that must be borne with.

The introduction of block signaling into American railway practice did not wait for the public demand, which took concrete form after a collision at a suburban station near Washington under the very shadow of the national capitol. Years in advance of that time a great many large railroads had well-developed block systems in use, and the American railroad officer was thoroughly alive to the advantage of the block system under certain conditions long before the public knew what a block system was.

The Nature of the Block System.

Briefly stated a block system on a double-track railroad is an arrangement of signals along the track which are so operated that whenever a train passes one of them the signal assumes the indication for stop and so remains until the train has passed a *certain distance beyond* it, after which it may give the proceed indication to another following train. In this way the trains are kept spaced theoretically an equal distance apart, this distance being intended to be great enough to insure against danger of collision in case the leading train stops suddenly.

As a matter of fact this spacing contracts and expands a good deal like the rings of a snake

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FIG. 5. ANCHORAGE FOR PIERS OF THE CHAUDIERE DAM.

FIG. 6. REINFORCEMENT FOR PIERS OF THE CHAUDIERE DAM.

Fig. 7. Double Stop-Log Made by Bolting Two Logs Together.

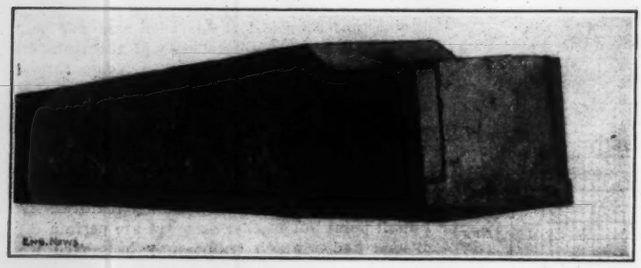

Fig. 8. Bottom of Log, Showing Lifting Socket Plate.

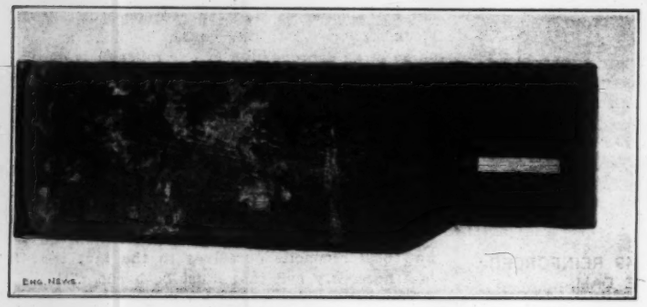

Fig. 9. Upper Side of Log Showing Thrust Plate at Top of Socket.

FIGS. 7, 8 AND 9. STOP-LOGS FOR THE CHAUDIERE DAM.

as it crawls along, because the leading train may stop just beyond a block signal, leaving the block behind it clear, through which the following train passes and stops at the block signal, possibly only a few feet behind the leading train, thus closing up the interval to almost nothing. Then when the leading train starts up again the following train must wait at the block signal until the leading train has gone the required distance beyond it, the space interval between them increasing all the while.

On a single-track railroad the block signals must be so arranged that they will protect the rear of each train exactly as described for a double-track line, and further other signals must be arranged governing movements in the opposite direction to that in which the train we are now protecting is moving, which signals must always give the stop indication some distance in advance of the train as it moves along, thus protecting it from being run into head-on. Of course these second signals are used also for the purpose of protecting the rear of any train running in the direction opposite to that we are describing.

In other words, a block signal simply does the duty that a flagman with a red flag or red lantern would do under the flagging rules. In order to give an engine runner a chance to get his engine under full control so as to stop his train before overrunning the stop signal, cautionary signals are often provided, which are reached some distance before the "home" or stop signal. These cautionary signals can give a proceed indication only if the home signal which they repeat is at "proceed"; they may, however, give a cautionary indication even when the home signal is set at "proceed," and they *must* give it if the home signal is at "stop."

The entire duty of a *block signal* is given above. There are a great many signals used on railroads which are called block signals by persons not familiar with railroad operation, but which are erroneously so called. Only yesterday I was on a railroad train which stopped at the home signal of an interlocking plant which protected a grade crossing over which a long freight train was pulling. A passenger in front of me looked out of the window and then remarked to his companion, "Oh, we're stopped by the block signal."

Manual Blocking.

Block signals are divisible into two classes, *manual* and *automatic*.

Manual block signals are moved to give the proceed or the stop indication by a block operator or signalman who is stationed in the vicinity of the signal. This signalman is in communication by electric bell, telephone or telegraph with similar signalmen or block operators stationed on either side of him, each of whom controls a signal like his own, and each of whom in turn is in communication with other signalmen still further beyond. The points at which the signals and signalmen are stationed are known under the American Railway Association's rules, which have been adopted as standard, as *block stations*.

Where manual blocking is in force two sets of signals are worked by each signalman, one for movements in one direction and one for movements in the other. With a double-track or four-track railway this carries with it, of course, that one set governs movements on one track and one on another. Sometimes these signals are displayed from one mast and sometimes from separate masts, but the principle is the same in either case. On single-track-lines, the almost universal practice is to display both signals from one mast.*

Imagine a series of block stations, *A*, *B*, *C*, *D*, *E*, averaging we will say three miles apart. The distance, *A B* (3 miles), is one block, *B C* another, *C D* a third, and *D E* a fourth.

Now imagine a train moving from *A* towards *E*. Signalman at *A*, if he knows the block *A B* to be clear, i. e., unoccupied by another train, sets his signal at "proceed," at the same time notifying *B* that he has done so. If it is a single-track line *B* will hold his signal governing the movement toward *A* at stop until the train which *A* has admitted reaches his station. If it happens to be a double-track line this is unnecessary, except (as will be explained later) where trains are run "against the current," i. e., eastward on a track intended for westbound movements, northward on a track intended for southbound movements, etc. As soon as the train passes *A*'s station, *A* restores his signal to the stop indication, which is its normal position, and refuses to clear it until *B* reports to him that the train which he (*A*) admitted to the block has passed *B*'s station. The same process is followed by *B* and *C*, *C* and *D*, *D* and *E*, and any number of other pairs of stations that may be included in the system. In this way each train on a double-track line is sure that it has a stop signal displayed behind it at all times and on single-track is sure that it has one behind it and one ahead of it, which is all there is to any block system.

Automatic Blocking.

With an automatic block system the principles of blocking are exactly the same as far as the display of the signals is concerned. No signalman, however, is employed to manipulate them. They are arranged so that each of them gives the stop indication automatically as soon as a train has passed it, and remains so until the train has passed the next signal in advance. It is not the purpose of this article to go into the details of the mechanism by which this is accomplished. It is a simple arrangement of electric circuits using the rails of the track and the wheels and

*By "mast" the reader should understand that any support for the signal itself is meant.

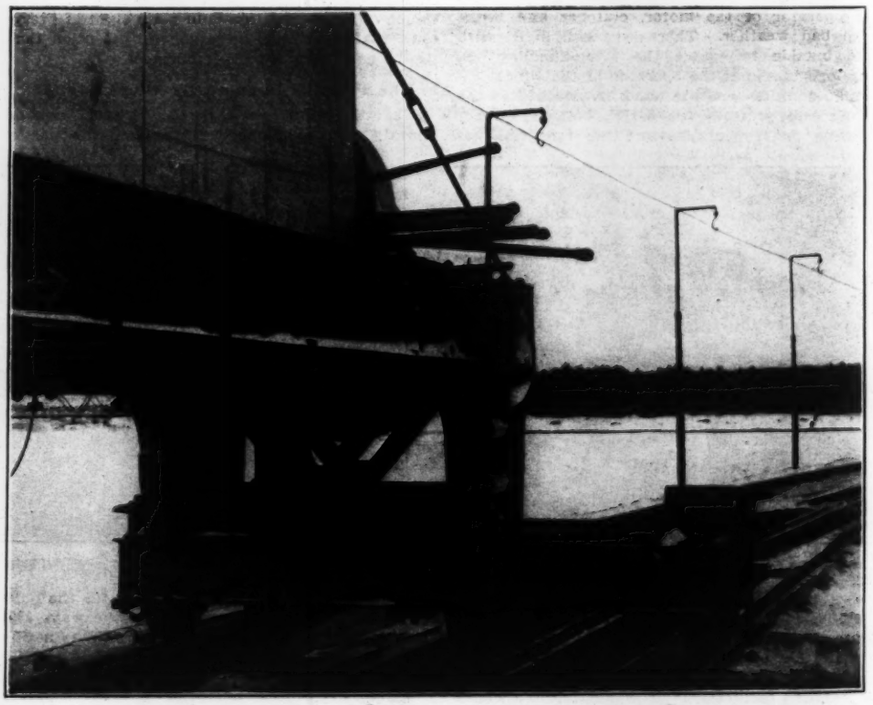

FIG. 10. ONE END OF THE CHAUDIERE DAM STOP-LOG WINCH AT CLOSE RANGE.
(This view shows the anchor hooks at ends of truck and one of the lifting rams.)

axles of the engine and cars as conductors, and is arranged to perform its duty by varied resistances.

Efficiency of the Two Systems.

MANUAL BLOCKING IN ENGLAND.—The manual block system was first inaugurated in England, where it has been in use for more than forty years with remarkable results as to safety. Without having any comparative figures at hand I will venture to say that the average density of traffic on English railroads measured in train units is greatly in excess of that on any American railroad (except possibly a few lines doing a large suburban business). Yet collisions are almost unknown there. I know it is high treason for an American to say that anything English is better than the same thing American, but I believe that any fairminded American operating railroad officer who will go to London and watch for a day the movement of trains in and out of St. Pancras or Euston Square stations, or at Clapham Junction on the London and Southwestern, will admit that they can show us a few things in regard to moving congested traffic over there that we don't know in America.

AUTOMATIC BLOCKING IN AMERICA.—The automatic signal is an American idea. In the early settlement of America when labor was scarce and high priced, the American was forced to resort to all sorts of labor-saving devices. He built snake fences because one man could do that alone, while a post-and-rail fence, or a board fence, required two men to erect. He drove his own plow team instead of letting some one else drive it, while he guided the plow. This developed a national mania approaching an inspiration to invent machinery which would perform a man's labor. Amongst other ways in which this spirit has reached the railroad is in automatic block signals. It appeals to the national appreciation of labor-saving machinery to think that a device can be put up alongside of a railroad track absolutely indifferent to the usual human frailties, forgetfulness, sleepiness, etc.

After a test of more than twenty years, however, the automatic block signal does not appear to produce the results that were at one time claimed for it.

THE ACCIDENT RECORD.—On Feb. 23, 1907, the Interstate Commerce Commission presented a report to Congress which had been made by a special committee employed by the Commission to investigate the causes of railroad accidents and suggest any manner of improving conditions. In this report it is stated that from July 1, 1904, until June 30, 1906, a period of two years, 20 accidents had occurred due to disregard for, or failure of block signals. Of these, 13 had taken place on lines worked by manual block and seven on lines worked by automatic block. But the lengths of line working under the two systems, as reported by the Interstate Commerce Commission for Jan. 1, 1908, were: 47,876 miles of line worked by manual, and 10,803 miles worked by automatic block signals.

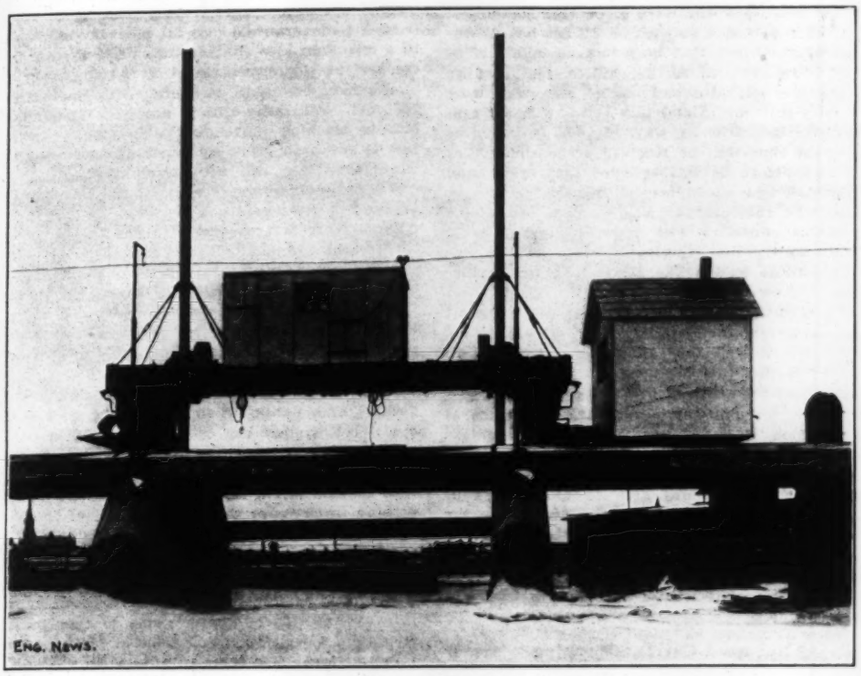

FIG. 11. STOP-LOG WINCH OF THE CHAUDIERE DAM IN ACTION: LOG PART WAY UP.
(The rack rails of the lifting rams rise several feet above the trolley wire.)

In other words, although about 81% of the block-worked mileage was worked manually, only 65% of the accidents due to disregard for or failure of signals happened on manual line. Undoubtedly the traffic measured in train units was heavier in the automatic than in the manual territory, but there certainly was not a great enough difference to account for such a variance in the figures.

In the three succeeding years the comparison is even less favorable to the automatic signal, as a perusal of the quarterly accident bulletins issued by the Commission shows. From July 1, 1906, until June 30, 1909, there were 33 accidents of the class described in block territory, 15 of which, or about 45%, were on automatically-worked lines, and the other 55% on manually-worked lines, while as of Jan. 1, 1909, out of a total of 59,549 miles of block-worked railroad, 20½% was automatic and 79½% manual.

Features of Automatic Signals.

SIGNALS NOT MANDATORY.—There appears to be some psychological reason why runners of locomotives do not have the confidence in or respect for an automatic signal that they have in a manual signal. One reason for this is that the automatic signal is what is known as a "stop-and-proceed" signal, while the manual signal is a "stop-and-stay" signal. An engine runner may under the rules proceed again immediately after stopping for a stop-and-proceed signal, it being understood, of course, that he must proceed cautiously until he meets with an obstruction or comes to another signal. The reason why this has to be is simply because all automatic signals are subject to occasional failures. They are so arranged that in case of failure they go to the stop position and stay there until repaired.

A good signal-performance record is say 20,000 signal movements to a failure; in fact this is probably better than the average. This means that on a 150-mile division, with blocks averaging 2 mi. in length and with a movement of 30 trains a day each way, signal failures average one in every 4½ days. If trains were not allowed to pass the signals in the stop position, it would mean that at each failure some train would be held up maybe for hours while waiting for a maintainer to reach the signal, completely blockading the entire line. Such an occurrence every 4½ days would be too serious an interruption to traffic to be tolerated. Consequently the adoption of the stop-and-proceed principle is unavoidable with automatic blocking. This in turn tends to foster a lack of respect for the signals among the enginemen.

Whatever the reasons are for the frequent disregarding of automatic signals by engine runners, the fact remains, and is one to be reckoned with. This is well evidenced by the fact that a few years ago the president of a well-known railroad, one which had gone extensively into the installation of automatic signals, issued an order that the signals should be so arranged that each train must have *two stop* and *one caution signal* displayed behind it. Such a rule operates on the theory, no doubt, that an engine runner is less likely to pass two successive stop signals than one—the Japanese principle of hiring one man to watch another, a third to watch the second, and so on *ad infinitum*, as far as you care to carry it.

COMPLEXITY OF APPARATUS.—Signal engineering until a comparatively recent date was confined to the manufacturers of signal apparatus. It was not until ten or twelve years ago that railroad companies themselves began to employ their own signal engineers. Even when the railroads did begin to employ their own men they frequently took them from the staff of some signal company, which men, though they were well trained from the manufacturing point of view, had had no railroad operating experience. A good deal of signal work, more especially in connection with automatic block signals, has been installed without any regard to operating conditions, and on the entirely erroneous hypothesis that there must be no possible loophole for an error, never mind how remote may be the chances of such an error occurring.

If all engineering was carried out along similar lines there would not be money enough in the United States to build one railroad from New York to Chicago. A bridge engineer calculates a bridge to be strong enough to carry the maximum reasonable load, with an ample factor of safety, and is satisfied, but he does not attempt to build it strong enough to resist the impact of a ten-ton meteor which may drop on it out of the heavens at any time. Signal engineers, however, pile one safety check after another on their devices until with automatic signals the circuits have become so complicated that nothing short of a first-class electrical engineer can maintain them. Thus, signal maintenance cost is greatly increased over what it was formerly, and the first cost of construction is enormous and without justification in the results obtained.

Features of Manual Signaling.

LONGER BLOCKS.—With manual blocking, the cost of employing the signalmen is, of course, the large item. It is impossible, therefore, to have as short blocks with manual as may be had with automatic block signals. About five-mile blocks may be considered a fair average where manual blocking is in force.

PERMISSIVE BLOCKING.—Because of the long blocks, it is quite frequently the practice, both in this country and in Great Britain, to use what is known as "permissive" blocking. Under permissive blocking rules one train is allowed to follow another train into a block after a certain established time has elapsed from the entrance of the leading train, the following train being warned before entering that the leading train is still in the block. In England this warning is given by stopping the following train at the home block signal; after it has come to a full stop the signalman displays a green flag to

the engine runner, which is authority for him to proceed. In the United States we give this warning by a special signal without compelling the following train to come to a full stop, or by handing the engine runner as he passes the block station what is known as a "form D caution card." Where the caution card is used the home block signal remains at the stop indication, but the signalman flags the train forward by hand. This performance results in the cautioned train's greatly reducing speed as it enters the block.

Permissive blocking should never be allowed except with freight trains. That is, no passenger train should be permitted to enter a block unless that block is known to be clear, and no other train, passenger or freight, should be permitted to enter a block which is still occupied by a passenger train. In this regard manual blocking is far ahead of automatic blocking so far as the protection to human life is concerned. All automatic blocking, as above explained, is virtually the same as English permissive blocking, in which the following train makes a full stop and then proceeds, *and this applies to passenger as well as to freight trains.*

Disregard of Signals Due to Ignorance.

Mr. James O. Fagan, in his "Confessions of a Railroad Signalman," lays strong stress on the fact that the larger part of the railroad accidents in this country are caused by the recklessness of railroad employees in the train and engine service, and therein I agree most heartily with Mr. Fagan. In the same work, and in his later one, "Labor and the Railroads," Mr. Fagan blames this recklessness largely to the influence of labor unions, in which conclusion I disagree with him. The organizations most interested in the movement of trains are the Order of Railway Conductors, the Brotherhood of Locomotive Engineers, the Brotherhood of Firemen and Enginemen, the Brotherhood of Railway Trainmen and the Order of Railway Telegraphers. These are all old and conservative orders and are as a general thing on terms of good understanding with the railroad companies.

My opinion, and I have given the question years of thought and study, is that this recklessness is due entirely to ignorance, not to contempt for established authority.

In one of his stories, Mr. Kipling has the narrator say that it takes a good deal to make a Chinaman realize danger, meaning thereby that a person who doesn't understand that he is in danger may appear perfectly reckless, when really it is because he doesn't know any better. The average American train or engineman is a healthy redblooded young animal as full of spirits and pranks and as restive under discipline as a schoolboy, but he is also a quick, intelligent man when his attention is called to the study of a question. So far as I know, no organized effort has ever been made by any large railroad company to give these men a thorough schooling in the use of and necessity for the safety appliances which are daily becoming more common on railroads, except in the case of the Pennsylvania Railroad, which I notice has recently equipped some cars as a signal school.

As an example of what can be done along this line, the following may be of interest:

A CASE OF EDUCATION.—In the year 1893 a certain large western railroad had for General Superintendent of one of its districts a gentleman who was a skilled train dispatcher, having served nearly twenty years in that capacity. Being a broad-gage man this gentleman had given a great deal of study to the manual block system, and had finally decided that 200 miles of double-track line in his district could be worked advantageously by it. His management was opposed to the change, however. The suggestion looked like such a radical departure from established practice that the higher officers hesitated. However, by virtually assuming all responsibility connected with the change, the General Superintendent was at last authorized to try it experimentally.

Now this gentleman not only understood train dispatching, but he knew the American railroad man from the ground up. Instead of publishing a few carelessly compiled rules in a bulletin announcing that the system would go into effect, he first visited every proposed block station and had personal talks with the operators, both day and night. If a man appeared slow to grasp the idea he stayed with him, or made him a second visit, until he was thoroughly convinced that the new system was understood perfectly by the operators who were to become signalmen.

He then posted a bulletin on all the boards announcing the fact that he would be in his office every Sunday until further notice, and that he would like all train and engine men who were off duty to come in and talk the new block system over in a friendly way. It was two months from the time that he received permission to try his idea before he was satisfied that every man interested understood his share in it.

He was subjected to a good deal of ridicule from his superiors who accused him of being afraid to try his experiment after he had authority to do so, but like Andrew Jackson's riflemen at New Orleans, he said nothing and held his fire until he was ready. The day came at last, and from then until the present that same block system and the same rules have been in effect. During this seventeen years not so much as one dollar's worth of paint has been scratched off a car through any failure of the block system, which, it is needless to say, has been extended all over the road. That road is moving as much traffic on a double-track line as some of its competitors are able to move on four tracks, and it may challenge any railroad in the country to show a better record for safety, trains on time and minimum overtime paid to freight crews.

This shows what a little education of the right sort can do.

Reversed-Current Working.

In the opening of this article I stated that under certain circumstances a train dispatching system is better than a block system.

In the first place the fundamental weakness of a train dispatching system is the fact that orders are given to the men who are to act on them sometimes an hour or more before they are to be acted on, leaving a great deal of time for men who are busy with other things to forget the intent of the order. If we could always insure that an order would only be given to an engine runner at the exact instant that he was to act on it, it would be just as safe as a visual signal.

Now on almost all double-track railroads one track or the other is idle a large part of the time, and if (as is always the case at certain hours of the day) the traffic is all in one direction, it becomes very convenient to cross some trains over and run them against the current. No block system yet devised provides for this sort of working in a satisfactory way. But it is the simplest thing in the world with a good manual block system to make this move *by using train orders.* The orders must be given to trains at the time they are being crossed over. One large railroad does and has been doing this daily for years, with perfect safety.

When we stop to consider that often this saves the building of one or two additional tracks at a cost of many thousands a mile, it is easy to see where the advantage comes in.

The Controlled Manual System.

So far I have said nothing about controlled manual block. This includes simply an extra safeguard thrown around the manual block and in no way alters its manner of operation.

The two signalmen at the ends of a block *A* and *B* are electrically connected with each other in such a way that *A* cannot clear his signal unless *B* unlocks him by closing a circuit at *B*'s station which energizes an electromagnet at *A*; and vice versa whenever *B* wants to clear his signal. This insures that the signalmen communicate with each other every time either wishes to admit a train to the block. Sometimes the arrangement is carried still further, so that the presence of a train in the block between *A* and *B* prevents either from clearing his signal, even if the other should forgetfully unlock him.

With the ordinary run of signalmen this arrangement may be of enough advantage to warrant its cost on single track, but on double track it is hardly necessary. With well-trained signalmen it may be dispensed with in either case.

The Question of Capacity of Line.

Some operating railroad men who have never tried a well-organized manual block system hold to a mistaken idea that an automatic system increases the capacity of the line (because shorter blocks may be used) without greatly increasing the cost. In reality this is not so. Where permissive blocking of freight trains is allowed they can follow each other by manual block working closer than they can with automatics.

The only difference is that where a freight is held on a passing track to allow a passenger train moving in the same direction to get by it, the freight cannot leave the passing track until the passenger train has passed through the block. As manual blocks will average probably two and a half times as long as automatic blocks, this means a few minutes longer wait for the freight train. This difference is soon made up under manual blocking by the fact that as above explained the freights can run closer together; and, again, when the freight does start out it has a clear run of the whole block, while with the automatics if it overtakes the passenger, it must stop for the block signal, losing more time than it would have lost had it stood on the passing track six or eight minutes longer.

Summary.

In the foregoing pages I have endeavored to discuss the block signal question in a general way and to explain why, after 27 years of active railway experience, I have come to the conclusion that a well-organized manual block system is better and safer than an automatic system.

Congress, however, has done all it could to prevent the extension of manual blocking, by passing the so-called nine-hour law, a measure which cannot possibly benefit the cause for which it was ostensibly enacted and which savors strongly of a gallery play.

A law requiring engine and train men running interstate trains to pass an examination in signaling and take out licenses such as Mississippi River pilots have to have, would do more good than any nine-hour law ever can do. But it would not be as popular with the men.

After all has been said and done, however, there are more ways by which passengers are killed and injured or by which property is damaged in railroad operation which could not be prevented by block signals than there are those which could be so prevented.

Of the 958 train accidents specially reported in the quarterly bulletins of the Interstate Commerce Commission for seven years, July 1, 1902, to June 30, 1909, as "prominent," only 363, or about 38%, might have been prevented by block signal working; 49, or about 5%, were due to disregard of block signals by engine and trainmen; and 33, or 3.4%, were due to failure of block signal apparatus. The remainder, more than 53%, were due to causes over which block signals would have had no preventive influence.

DRAINAGE EXPERIMENTS IN CONNECTION WITH small bodies of land submerged as the result of irrigation are thus briefly described, in a statement issued by the United States Reclamation Service relating to the Minidoka irrigation project in Idaho. The statement is as follows:

"At one point a lake covering about 80 acres had formed. A well was sunk near the lake to a depth of 100 ft., the last 30 ft. penetrating the lava rock which underlies the whole project. A 6-in. casing was put in to the top of the rock and the waters of the lake were directed into the well. For the past three weeks the water has been drained into the well at a rate varying from 1 to 3 sec.-ft. or an average flow of more than a million gallons per day. Should other wells prove equally effective it is believed the problem of drainage on this project can be solved without the necessity of constructing long and expensive drain ditches to carry the surplus water to the river."

Septic Tank and Contact Beds for Treating the Sewage of Cherryvale, Kan.

By J. S. WORLEY,* Assoc. M. Am. Soc. C. E.

In 1903-4 the city of Cherryvale, Kan., which has a population of 6,000 people, installed a system of sanitary sewers. To these were added a few extensions until in 1909 the total length of sewers was seven miles. The outfall sewer had its outlet about one mile west of the center of the city, emptying into a dry ravine. This ravine extended to the west through some valuable farm lands for a distance of about two miles, where it joined the Verdigris River.

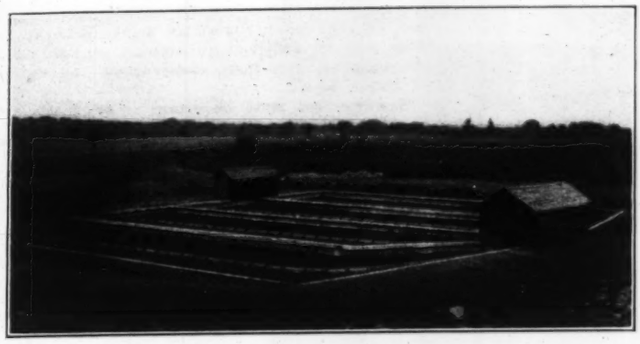

FIG. 1. VIEW OF CONTACT FILTERS FOR TREATING EFFLUENT FROM SEPTIC TANK, CHERRYVALE, KAN.

In 1906 the discharge of crude sewage into the ravine became such a nuisance that the installation of some method of purification was necessary. After some investigation it was decided to construct a septic tank. This septic tank had an approximate length of 60 ft. and a width of 18 ft., with a sewage depth of 8 ft. The tank was divided into three compartments, 4, 6 and 8 ft. in width. Entrance of the sewage was through a grit chamber from which it passed into each chamber of the septic tank through an 8-in. valve placed at the surface of the sewage. The effluent from each compartment passed through a 6-in. opening placed at the same level as the surface of the sewage in the septic tank. Such an arrangement provided no means for governing the amount of flow which entered the several compartments, and under normal conditions the small compartment would handle the same amount of sewage as the large one. The openings from the septic tank being placed at the level of the sewage in the septic tank made it very easy for one of the openings to become partially stopped and nearly all the sewage pass through one compartment.

Each compartment was provided with three baffle boards which extended from the surface of the sewage to within 2 ft. of the bottom of the tank.

From the time this septic tank was put into operation it was of little value and the percentage of purification was very small. During the summer of 1908 and the first of the year 1909 the conditions below the outfall sewer had become so bad that a nuisance had been created. The banks of the dry ravine, which was now carrying the effluent from the septic tank, had become covered with a black deposit and during the hot months a bad odor arose.

In consequence of the conditions stated the owners of the property through which the dry ravine passed entered suit for a heavy damage and asked for a permanent injunction restraining the city from emptying sewage into this ravine. The granting of such an injunction would have meant the closing of the seven miles of sewers, which would have been an irreparable damage to the city, so after hearing the evidence the court withheld its decision and suggested to the city that it make a strenuous effort to remedy the condition.

At this time the writer was called in to make examinations and studies and to recommend to the city what should be done. A complete examination of the system of sewers and the operation of the septic tank was made. It was found that a large part of the sewage was passing through the small compartment and was retained therein only an hour or so. The larger compartments were holding the small amount of sewage they received for an indefinite period. Such conditions of operation were due to the method or lack of means for regulating the flow of sewage to each compartment.

It was also found that a large amount of rain water was entering the sewers, approximately three times the normal flow, and that after a rain this water would rush down to the septic tank and pass through with considerable velocity. This velocity was increased by the baffle boards, which reached to within 2 ft. of the bottom of the septic tank, to such an extent that the sludge and other solid matter was scoured out after a rain and deposited along the banks of the ravine.

Recommendations were made to the council and the writer was authorized to prepare plans and specifications, to receive bids and contract for remedying defects in the existing sewer system and septic tank, and construct such a purification plant that the effluent would not create a nuisance. The first work was to cause all down spouts of buildings to be disconnected from the sewers, and to have the tops of 80 manholes raised so as to exclude rain water entering through the perforated holes.

Next the division wall between the two small compartments in the septic tank was removed, so as to make two compartments, and all baffle boards were taken out. The openings between the grit chamber and the compartments were closed up and new openings placed 2½ ft. below the surface of the sewage in the septic tank. These openings were made large and their areas were made proportionate to the cubical contents of their respective compartments.

At the outlet end a weir was constructed across the whole end of each compartment. This weir had a baffle board located 2 ft. away which held back the sludge. This baffle board extended down a distance of 6 ft. The weir was so constructed that it regulated the outflow from each compartment.

In addition to reconstructing the septic tank a method of secondary purification was provided. This consisted of four contact filters, as shown in the view, Fig. 1. Upon examining the ground it was found that a very compact strata of stone was located at about the elevation the floor of the filters would come. In consequence thereof the ground was excavated down to this rock and after the rock had been leveled off it was used for a floor. Concrete walls were carried down to this rock. Channels were excavated in the rock, so they would drain to the points of outlet, and the channels were covered with split vitrified pipe.

The question of filtering material is one of the most importance in designing and constructing a purification plant. Generally very poor material is available, and when the same is found it is necessary to transport it from some distant place. After studying all ordinary available local material it was found that there were thousands of tons of refuse from zinc smelters near by which consisted largely of broken retorts. The retorts are made of a kind of fire clay and while in use are subjected to such intense heat that they are vitrified. After careful study of the material and a series of tests it was decided that this was the best and cheapest material available.

A crusher was set up at the site of the purification plant and the retorts, after being crushed and screened, were placed direct into the beds (see views, Figs. 2 and 3). The cost of this filtering material is about one-half that which would have been paid for cinders or broken stone.

The plant was designed to operate automatically. Miller air-lock alternating devices are used for dosing the beds and timed syphons for discharging them.

The plant has now been in operation for three months and is giving excellent results. The

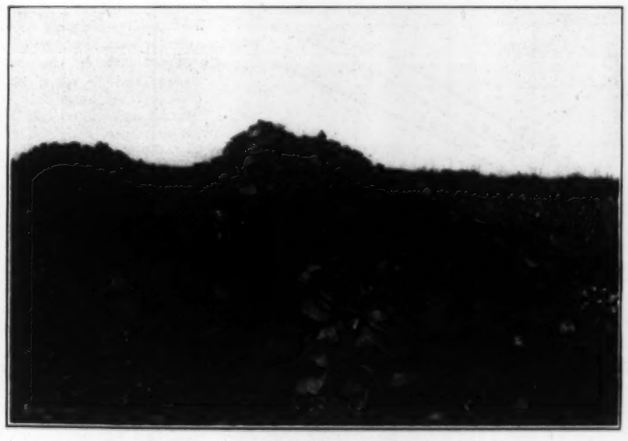

Fig. 2. Before Crushing.

Fig. 3. After Crushing.

FIGS. 2 AND 3. ILLUSTRATING USE OF BROKEN ZINC-SMELTER RETORTS FOR CONTACT FILTERS FOR SEWAGE TREATMENT, CHERRYVALE, KANSAS.

*President of the J. S. Worley Co., Engineers of Public Utilities, Reliance Bldg., Kansas City, Mo.

effluent is perfectly clear and no odor noticed. The injunction suits have been dismissed.

The writer visited the plant early in May, 1910, and examined the banks of the ravine for the greater part of its length. The black deposits had disappeared, and everything was in a sanitary condition. On this same visit it was observed that in a small pool some 4 to 6 ft. in diameter, and 1 ft. deep, which is located at the mouth of the outfall from the contact filter, there was a school of some two dozen fishes.

In response to a query from the editor, Mr. Worley submits the following comments on the possibility of having used the inlet valves to apportion the flow of sewage to the different compartments of the septic tank.—Ed.

Where gate valves and sluice gates were used for controlling the flow of sewage from a grit chamber into two or more compartments of a septic tank, the writer's observations have been in all cases that the flow was not in proportion to the cubical contents of each compartment and that the valves could not be throttled so as to regulate this flow.

Where the flow of sewage through the different compartments of a septic tank are not uniform, good results can not be obtained. The reason good control cannot be obtained with valves is that refuse and heavy matter will begin to collect along the side of one of the valves to one of the compartments and in a little while this valve will become partially or entirely closed by this refuse matter.

The writer has found that the best results in governing the flow of the sewage through septic tanks containing several compartments is to place as large an opening as convenient between the grit chamber in each compartment of the septic tank. This opening should be placed about 2 ft. below the surface of the sewage, and have an area such that the ratio to the area of the other compartment opening is the same as the ratio of the cubical contents of each respective compartment.

At the lower end of each compartment of the septic tank an overflow weir should be provided which should be of length that the ratios of the length of the weirs for each compartment is the same as the ratio for the cubical contents of the respective compartments. By the above means the entrance and outlet openings of the various compartments of the septic tank assist in keeping the flow uniform through each respective compartment.

An Experiment to Determine the Pressure of Concrete upon Forms.

By L. E. ASHLEY.*

The construction of the concrete foundation to support a chimney 175 ft. high for the new boiler house at the University of Illinois offered an excellent opportunity to make a test to determine the pressure of concrete on forms. This foundation above the footing is octagonal in outline but circular inside; it is 18 ft. in short diameter, 3 ft. thick at the thinnest point and 12 ft. high.

In designing the forms it was a question for the contractor to decide how much wire was necessary. Every concrete hand-book advises the use of wire to support forms but neglects to state how much wire to use per sq. ft. of form area. The only practical information on the subject is that found in the tests of Major Francis R. Shunk in 1908, the results of which were published in Engineering News Sept. 9, 1909. With his results as a basis the wire was proportioned for these forms. It seemed at the time that his results were rather high, approaching too nearly hydrostatic pressure.

With the collaboration of Mr. B. A. Abrams, Associate, Engineering Experiment Station, University of Illinois, a device for measuring pressure of concrete on forms was designed, which eliminated the friction encountered in Major Shunk's test and simplified the method considerably. The apparatus consisted of an oil-packed, hydraulic jack placed in a horizontal position with a plate bolted tightly to the free end of the plunger. This is shown in Fig. 1. The plates used had an area of about 1 sq. ft. To prevent any chance of a restraining action of the concrete, the plate extended about ½-in. beyond the inner face of the form through a circular hole cut slightly larger than the plate. A piece of canvas was tacked securely to the form over the hole cut in the form so that the concrete could not ooze out or become clogged between the plate and the form. Two ¾-in. rods were used

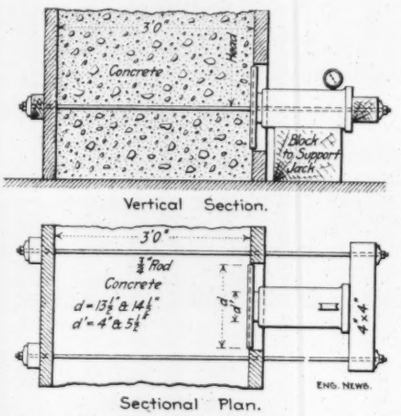

Fig. 1. Apparatus for Testing the Pressure of Concrete on Forms.

to take the reaction due to the pressure of the concrete on the plate, while a wood block supported the jack and assisted in holding the apparatus in line. A hydraulic gage was used to measure the pressure on the alcohol in the jack.

Two independent measuring devices were used in this test, placed about 90° apart in the form. It is felt that this apparatus is well adapted to this kind of a test. Moving parts and the accompanying friction which are generally so troublesome, are almost entirely eliminated in this device; the plungers of the jacks are nearly free from friction and the plates had no contact with the form.

The form was filled with a 1:4:4 wet mixture at the rate of about 1.3 ft. per hour to a depth of 6 ft. The outside temperature was about 30° F., with a variation of about 1° during the test. The concrete was deposited in layers of about 6 ins., observations of depth of concrete and gage readings being made after each layer had been churned in the usual manner. Only 6 ft. of concrete was placed at one time.

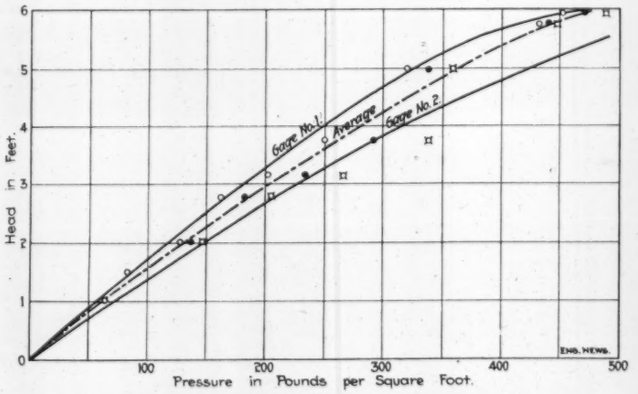

FIG 2. DIAGRAM OF RESULTS OF TESTS OF PRESSURE OF CONCRETE ON FORMS.

From the accompanying table of results it is noticeable that there is some variation in the pressure per sq. ft. for the different jacks. This variation may be caused by the unequal tamping at the different positions, thus causing a greater tendency toward an arching effect of the concrete around the plate.

From a comparison of the curve showing the relation between the pressure and head (Fig. 2) with that of Major Shunk, it is evident that the pressure is considerably lower for the same head, varying quite a little from the hydrostatic pressure. Whether this is due to an arching effect of the concrete, the friction of the concrete along the form or to a difference in the accuracy of the apparatus, is a question which no simple experiment like the one here undertaken will decide. With the apparatus used it is not necessary for the concrete to be displaced inward by the head-plate or to follow up the head-plate in taking readings. This arises from the fact that the movement of the plunger is so small that it can be considered almost as being immovable. This may be sufficient to account for the discrepancy between these observations and those of Major Shunk.

However, the most important result seems to be that the pressure on forms is much lower than has been shown heretofore; this, considering the nature of concrete as compared with water, seems quite reasonable.

TEST OF PRESSURE OF CONCRETE UPON FORMS.

			Jack No. 1.		Jack No. 2.		
Time.	Head of concrete, ft.	ins.	Gage readings per sq. in., lbs.	Actual pressure per sq. ft., lbs.	Gage readings per sq. in., lbs.	Actual pressure per sq. ft., lbs.	Av. pressure per sq. ft., lbs.
10:15	1	0	5.00	63.5	....	....	63.5
10:30	1	5	6.50	82.5	4.0	83.0	82.8
10:50	2	0	10.00	127.0	7.0	145.0	136.0
11:25	2	6½	12.75	162.0	9.9	205.0	184.0
12:00	3	1½	15.80	201.0	13.0	266.0	233.0
12:00 to 12:30; no work done.							
1:20	3	8½	19.50	248.0	16.5	338.0	293.0
2:10	5	0	25.00	318.0	17.5	358.0	338.0
2:45	5	9	34.00	432.0	21.8	447.0	440.0
3:10	5	11	35.60	453.0	23.7	487.0	470.0

A Comparison of the Horse and the Gas Traction Engine.*

By L. W. ELLIS.†

Endurance is the horse's weakest point. Ten hours a day is often assumed as his working period. Authorities claim that eight hours is better, or that six under a heavier load will accomplish the same volume of work with less tear and wear on the horse. The average farm horse cannot be depended upon for more than 13 to 15 miles of pull a day, nor more than four to six hours of work per day, as an average of even the busiest months. A gas tractor will net 17 miles of furrow travel in ten hours, and double this in 24, with all turns extra.

Properly handled, working about six hours a day, well and carefully fed, a horse may have a working life of ten years of 1,000 hours each. Where used on street car systems, his life of usefulness is from two to four years. The average farm horse will do well to develop 500 HP.-hours per year or 5,000 in ten years. A tractor, carefully looked after, would probably double this for each rated HP.

About 20% of the horse's weight may be taken as his maximum sustained draft, and six to eight miles per hour his maximum sustained speed for anything more than an hour or so per day. The draft horse ordinarily gives the largest volume of work per day at about one-half his maximum load, and one-third his maximum speed.

One reason for the great flexibility of the horse is the fact that he works most economically at about 1 lb. of draft for 10 lbs. of weight, or from 50 to 20% of the rate he can exert in a pinch. The horse would not last long if run at or near the maximum working power, while the traction engine is made to run at nearly full load the entire line. In the motor contests at Winnipeg last year the gas tractors exerted 1 lb. of draft for 4¼ lbs. of weight on a good sod footing, and for 6 lbs. of weight on a soft dirt and gravel course. The average horse develops one useful horsepower for 1,500 lbs. of weight. Nine of these tractors, which completed all the tests, developed 1 brake HP. for 465 lbs. of weight, and under both good and bad footing 1 tractive HP. for 922 lbs. of weight.

The horse needs a drink and food after every seven

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†The Rumely Co., La Porte, Ind.

to eight miles of plowing, but of course can be forced to go a greater distance. Some of the best known gas tractors could go from 10 to 15 miles under full load if it were possible entirely to empty the fuel and water tanks without stopping. Actually they need water about as often as the horse. Others of different type could go for 15 to 20 miles without fuel and several times that without water, with their present tank capacity. A better balance in this respect would render the tractors more convenient, and undoubtedly some weight would be eliminated in so doing. A steam plowing engine does well to travel two miles on the water taken in during 15 mins. The gas tractor on the farms is seldom called upon to go far from the sources of supply; hence has no need to carry dead, useless weight. Probably 95% of the weight may be put into metal, 2½% into the cooling water and 2½% into fuel. The latter may be increased easily in tractors designed for use in dry stretches.

The gas tractor cannot compete with the horse as a hauling proposition on heavy grades. The elimination of steep grades, which a horse may surmount by the expenditure of greatly increased energy, but which exhaust the overload capacity of tractors, will mean not only an increased use of mechanical motors for hauling purposes, but an excellent field for traction machinery in the building and maintenace of good roads.

One man in the field may handle four to six horses, developing from 2½ to 4½ HP. Two men on a gas tractor will handle an outfit doing from 10 to 20 times the work. To care for a traction engine doing the work of 25 horses requires approximately the same time in the course of a year as to care for one horse. The cost of a building for sheltering a 25 HP.-tractor is approximately 10% of that required to shelter 25 horses and their food supply for a year. The fuel for a gas tractor occupies about 2½% of the space required for the feed of 25 horses.

One great danger, however, besets the tractor and that is the presence of the weak bridges which span our streams.

The day can be foreseen when the farmer will want two tractors: one a massive engine for rapid, heavy work; the other a light nimble motor for cultivating and other light tasks. He has never expected the same horse to draw both the heavy plow and the light road wagon, at a wide range of speeds. Neither should the builder of a gas tractor expect seriously to compete with all classes of horses by offering a machine half automobile and half traction engine.

A Polar Planimeter for Averaging the Records of Circular Instrument Charts.

As the class of recording instruments using circular charts have come into extended use for measuring all sorts of varying quantities, such as pressure, voltage, current, power, temperature, etc., a demand has arisen for a simple mechanical device to average accurately and quickly the values shown on the chart for a given length of time. Such an instrument was devised by Prof. W. F. Durand, of Stanford University, Palo Alto, Cal., and described in a paper before the American Society of Mechanical Engineers, Dec., 1908. Recently this instrument has been adopted by Prof. W. H. Bristol to the charts of meters made by the Bristol Co., of Waterbury, Conn. The Bristol-Durand device is shown in Fig. 1.

It is necessary to have polar charts graduated with uniform values of the radial scales just as in rectilinear charts the vertical ordinates must show equal graduations for averaging with the ordinary planimeter. With this polar planimeter, the object is to find the mean radius (corresponding to and in terms of mean pressure, voltage, current, temperature, etc.) for a given time angle. The common planimeter would measure the area enclosed by the polar curve; this area is proportional to the angle and to the square of the radii. The square root of mean square of radial ordinate can be determined from this, but that is not equal to the mean radius.

The operation of the instrument is understood from Fig. 2. A B represents a curve assumed for the moment to be traced by a point moving in a radial direction as the chart revolves about the center O. Here also is the slotted and pivoted socket through which the rod P Q can freely slide. The wheel W is fixed on the rod and is graduated in the same general way as the wheel of an ordinary planimeter. The design shown in Fig. 1 has a 6-in. aluminum wheel graduated into 100 equal spaces and fitted with a vernier reading to tenths of a division. The wheel is of such size that no device for counting the number of revolutions is considered necessary; for a maximum record on the 12-in. charts, the number of complete revolutions would be no more than two.

The curve of the chart is followed by the pointer P (Fig. 2) and the radial movement of the bar is made by the handle Q which is conveniently held by the thumb and finger as the chart is turned, about O with the other hand.

It is seen that the wheel W revolves for the circumferential component only of the curve traced. The movement of the wheel will be proportional to the lengths of radius W O and to

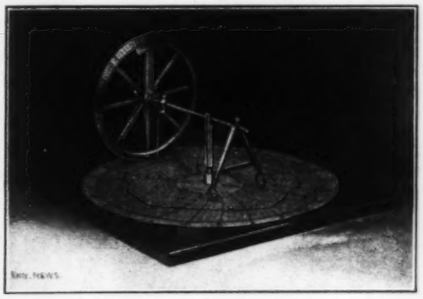

Fig. 1. A Planimeter For Circular Meter Charts.

the angles moved through by the arm P Q. If this reading is divided by the angle, in circular measure, the quotient will be proportional to the mean radius O W. To remove all proportionality factors, making the device quickly adaptable to any chart, a calibration curve is drawn for each style of chart with the planimeter having the pointer P and the edge of the wheel one grand division apart. Each calibration sheet carries a straight line across the ordinates between plotted points which show the wheel reading for one revolution of the chart about its center O with the pointer at maximum and initial radii respectively. Abscissae of the calibration sheet show wheel readings then and ordinates the true corresponding radius, for a complete chart record

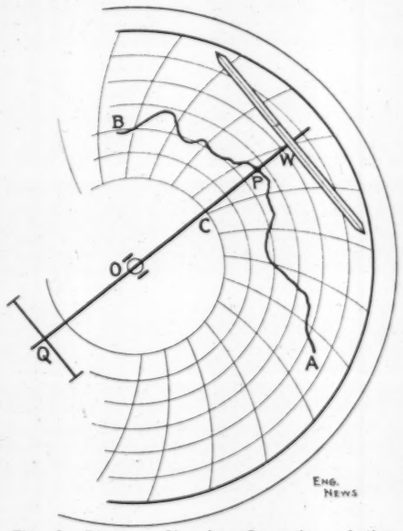

Fig. 2. Diagram Showing Operation of the Bristol-Durand Planimeter.

—usually 24 hours. For an incomplete chart, multiply the number of hours and divide by 24.

It was assumed that the curve was traced by a point moving in a radial direction. Now as the charts show the trace of a point moving through a curved path it is necessary to correct for the circumferential component of this "curved radius." This is automatically done by returning the pointer along the curved radius until it is at the same distance from the center as was the starting point. Thus the circumferential components of a movement beyond the starting point are balanced by the component of the return path.

The Growth of Electricity Supply Works in the Years from 1902 to 1907.

A bulletin recently issued by the U. S. Bureau of the Census, discloses a few general statistics on the operations of central electric-light and power stations in 1907. This bulletin is an abstract of the regular statistical census report soon to be published, as prepared under the direction of Mr. W. M. Steuart, Chief Statistician, with Mr. T. C. Martin and F. L. Sanford, of New York, as special consulting experts. Some of the new figures are presented below with those similar in the report of the 1902 census for comparison.

In 1907 the total number of central stations was 4,714 as compared with 3,620 in 1902—an increase of 30.3%. These several stations had a total generator capacity of 2,709,225 KW.; in 1902 this figure was 1,212,235, showing an increase of 123.4%. The number of these generators decreased from 12,484 to 12,173 (2.5%), while the average size of machine ran from 97.3 KW. for 1902 to 226 KW. for 1907—an increase in size of 132%. The capacity of alternating-current machines meantime rose 201.7% over the 1902 figure—from about 736,000 to 2,220,000 KW. This is 82% of the total generator capacity. There were 10,150 prime movers rated at 4,032,635 HP. as compared with 7,428 units in 1902 having an aggregate rating of 1,830,594 HP. These figures show an increase in number of prime movers of 35.6%; in aggregate capacity 120.3%; and in average capacity of prime mover 62.5%—from 245 HP. to 398 HP. Of the reported horsepower about 33% was from water power and 66% from steam. In 1902 only about 25% was from steam. Gas power cut very little figure in either year.

The total output of all these plants was reported as 5,862,276,737 KW.-hrs. as compared with 2,453,502,652 KW.-hrs for 1902—an increase of 139%. The number of incandescent lamps in use was estimated at 41,445,997, as compared with 18,194,044 in 1902—an increase of 127.9%. The number of arc lamps supplied increased 44.1%—from 385,698 to 55,713. In 1907 there were reported 162,338 electric lamps of "other varieties." The nearest approach to such lamps in the 1902 report were the 2,259 miscellaneous small arcs for theaters, photographic studios, etc.

These 4,714 concerns employed 47,632 salaried men and wage earners who received $35,420,324 per year. The 3,620 concerns reported in 1902 employed 30,326 such men and paid them $20,646,692. The gain in numbers employed is 57.2% and in pay 71.7%. The salaried men in 1907 received an average of $805 per year per man, while the wage earners received $685 as an average. In 1902 these figures were $810 and $644 respectively.

As might have been expected small central stations predominate; 81.8% were of less than 500-KW. capacity in 1907 and 87.7% in 1902. Also, it is worthy of notice that 64.4% in 1907 and 71.5% in 1902 were of less than 200-KW. capacity.

Of these 4,714 central stations, 3,462 or 73.4% were privately operated in 1907 and 1,252 or 26.6% were municipal plants. In 1902 there were only 815 municipal plants or 22.5% of the total (3,620). Thus the gain in number of private stations in 1907 over 1902 was 23.4% while the increase in number of municipal plants was 53.6%.

In the bulletin at hand, these stations are again divided into the "purely electric" and the "composite." About 65% of the private plants were reported as purely electric in 1907 and 42% of the municipal plants were similarly operated. The 1902 figures do not furnish a similar analysis. The bulletin contains the following paragraph on composite stations:

These 2,066 composite stations were associated with 2,306 industries of various kinds, the excess of industries being due to the fact that a single central station may be associated with several other industries. The association of central stations with water-works and gas plants is the most common, and for the municipal plants there was practically no other. For the commercial stations, there were 995 operated in connection with such public services as water-works, gas works, street railways, steam heating, and the manufacture of ice, and 573 stations operated in connection with some other

business. The central stations associated with such industries as sawmills, gristmills, manufactured ice, and cotton gins are likely to be of secondary importance, and owe their existence to the facility with which surplus primary power, by use of the dynamo, may be converted into electrical energy and transmitted for service as light or power to near-by or remote points.

Concerning municipal stations a special bulletin, devoted to them, makes the following statements:

While the proportions for the chief items for the commercial stations are decidedly greater in the "purely electric" class, this does not hold true for the municipal stations, where such important totals as income, expenses, horsepower of primary-power plant, capacity of dynamos, and number of incandescent lamps are greater for the "composite" stations. The fact that such public utilities as water and gas are so often operated by municipalities which also operate electric stations largely explains this condition. Exclusive of the item of arc lamps, about 6% of the income of the "purely electric" group was reported by the municipal stations, as compared with about 10% for these stations in the "composite" group.

The stability of the municipal plants is exemplified by the fact that 774 of the 815 plants reported in 1902 also reported in 1907. Of the 41 which failed to report in 1907, 33 had become commercial stations, four had discontinued operations or were idle; two were connected with public institutions, the plants of which were excluded from the census of 1907; one was merged with another municipal plant because of the consolidation of two cities since 1902; and one was destroyed by fire and had not been rebuilt at the time of taking the census of 1907.

The total number of municipal plants in 1907 (1,252) was distributed, 150 in the North Atlantic States; 158 in the South Atlantic; 727, North Central; 166, South Central; and 51, Western.

Most of the municipal stations are in places of small population, nearly 87% of the total number being located in places of less than 5,000 and less than 3% in places having a population of 25,000 and over. In the three divisions—the South Atlantic, the South Central, and the Western—together only one station was reported in 1907 for cities of over 100,000 population, but in these three divisions together there were only eight cities of this class according to the census of 1900. In the North Atlantic division there were 16 cities of this class, with only two municipal plants in 1907; and in the North Central, 14 cities, with nine municipal plants. The one station reported for the South Atlantic division was in Baltimore, while the four stations in the "500,000 and over population" class of cities in 1907 and 1902 in the North Central division were all located in Chicago.

The total cost of construction and equipment was given from 1907 as $1,096,913,622, as compared with $504,740,352 for 1902—an increase of 117.8%. The total 1907 earnings were reported as $175,642,338, as compared with $85,700,605 for 1902—an increase of 105%. In 1907 the total earnings were 16% of the cost of construction and equipment; in 1902 the earnings were 17%. The earnings from lighting service in 1907 were $125,775,114; in 1902, $70,138,147—an increase of 79.4%. Earnings for all electric services in 1907 were $169,614,691, as compared with $84,186,605—an increase of 101.3%. Incomes from non-operating sources were $6,027,647 in 1907 and $1,514,000 in 1902—an increase here of 298%, showing the great increase in outside activity of electric-power concerns.

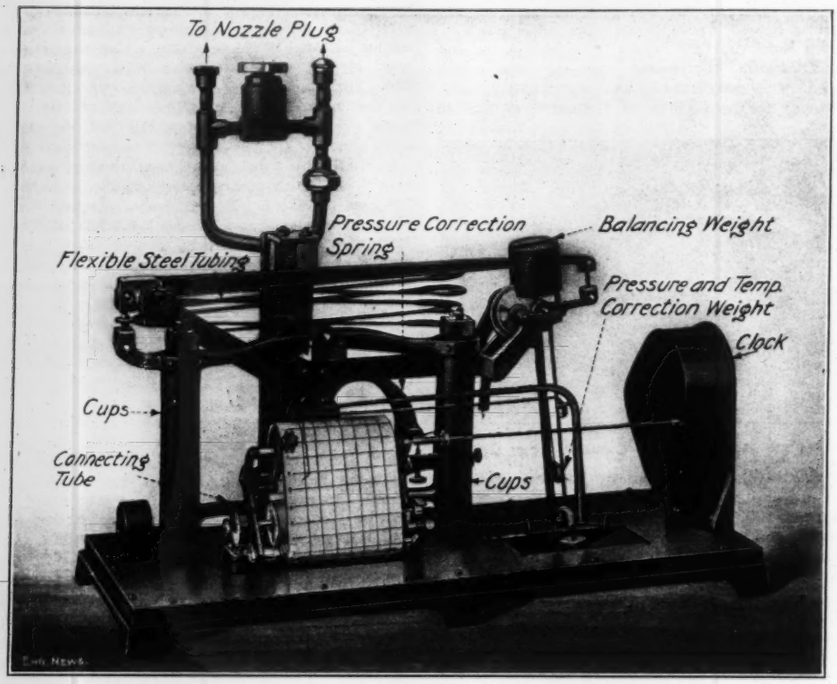

FIG. 1. A RECORDING, PITOT-TUBE, STEAM-FLOW METER.

A comparison of simultaneous growth of gas plants is made in the following paragraph of the bulletin:

Of the various industries mentioned, the manufacture of illuminating gas comes into the most direct competition with the generation of electrical energy. Comparing the sale of electrical energy with that of gas, the report shows an increase in 1907 of 101.5% for the central electric stations and 62.3% for the gas plants.

In 1907, 329 stations reported that they also operated gas plants, but this by no means represents the extent to which the consolidation of the interests of the two industries has been carried, since it does not cover instances wherein the whole, or a controlling portion, of the stock of one industry has been acquired by the other, and the companies are operated under separate management regardless of stock ownership. There is a growing tendency to merge the two industries, partly to avoid the sharp competition whenever they are common bidders for the same class of business.

The central stations are necessarily largely concentrated in populous districts. The states of New York, Pennsylvania, Illinois and Ohio, having together 29.6% of the population of the country, held 1,296 central stations, or 27.5% of the total number in service in 1907. The total annual output in these states was 2,553,745,890 KW.-hrs., or 43.6% of the total for the country. In ratio of stations to population the western states led, followed in order by the North Atlantic, North Central, South Atlantic and South Central groups.

The important percentage increases stated above are tabulated below for more convenient comparison.

	Percentage increase.
Number of stations	30.3
Private plants	23.4
Municipal plants	53.6
Generator capacity	123.4
Number of generators	—2.5%*
Size of generators	132.
Capacity in alternators	201.7
Number of prime movers	35.6
Total HP. in prime movers	120.3
Average HP. in prime movers	62.5
Total plant output	139.
Number of incandescent lamps	127.9
Number of arc lamps	44.1
Number officials and employees	57.2
Wages and salaries	71.7
Cost of construction and equipment	117.8
Total earnings	105.
Operating earnings	101.3
Non-operating earnings	298.

*Indicates decrease.

Pitot Tube Steam Flow Meters.

Some of the features of earlier experimental steam-flow meters may be recognized in a line of recording and indicating instruments which have been developed for commercial service by Mr. A. R. Dodge, General Electric Co., Schenectady, N. Y. They are all dependent for their operation on the difference in pressure between the leading and trailing nozzles of a form of pitot tube, shown in Fig. 1. These nozzles are openings in a cylindrical plug to be inserted in the pipe at the point where the flow is to be measured. The leading set of openings faces the flow and extends the length of the pipe while the trailing set consists of but two openings, one at 90° and the other at 180° from the direction of flow. The pressures caused to exist in the nozzles are carried to the outer connections of the plug through separate longitudinal passages. Connections to the meter are made by ¼-in. iron pipe.

The recording instrument (see Fig. 2) has a modified U tube, half full of mercury, carried on an arm balanced, with a counterweight, on a knife edge. The two connections from the nozzle are carried to each leg of the U tube through flexible steel tubing. The difference in pressure in the legs of the U tube is balanced by a displacement of the mercury level in the legs of the U tube. This causes an unbalance of the arm and tube as supported on this main knife edge. The movement is multiplied by two levers on knife edges and is checked when the moment of unbalance is equalled by the moment of a counterweight attached to the second multiplying lever and as the center of gravity is thrown from over the center of support by the movement of the levers (see Fig. 2). A long pen arm moves with the levers and a path is recorded on a chart unrolled by a clock mechanism. Correction for temperature variations (degrees of superheat) are made by hand, reducing the record to equivalent flow at a definite temperature. To automatically compensate for steam-pressure variations, a hollow helical spring moves a small correcting weight on the pen balance.

The indicating flow meter (Fig. 3) resembles one independently developed by Prof. G. F. Gebhardt, of Armour Institute of Technology,

Fig. 2. An Indicating, Pitot-Tube, Steam-Flow Meter.

and described before a meeting of the American Society of Mechanical Engineers last year (see Engineering News, July-Dec., 1909, p. 686). The connection from the pitot nozzles are brought to a modified U tube partially filled with mercury (see Fig. 4). The "static" nozzle connection goes to the larger leg, of the U tube, in

which is a float. A cord passes from the float over a counterweighted pulley on the shaft of which is a small permanent magnet at right angles to the shaft. This gearing is all enclosed in a sealed chamber above the mercury level of this leg of the U tube. The movement of the bar magnet, in response to changes in the mercury level, corresponding to changes in the velocity of flow, causes a corresponding motion in a similar magnet attached to the pointer and carried in a separate casing. This magnetic transmission makes any stuffing boxes on the indicating gear unnecessary. The pointer moves over the face of a dial marked with parallel spirals indicating various values of flow. Adjustment for various diameters, pressures and temperatures are made by setting the small cylinder attached to the auxiliary rack pointer. After this setting is made the rack is rotated by hand until the pointer coincides with the indicating needle. The curve on the dial passing through the point where needle and pointer coincide shows the instantaneous rate of flow in pounds per hour per square inch of pipe area.

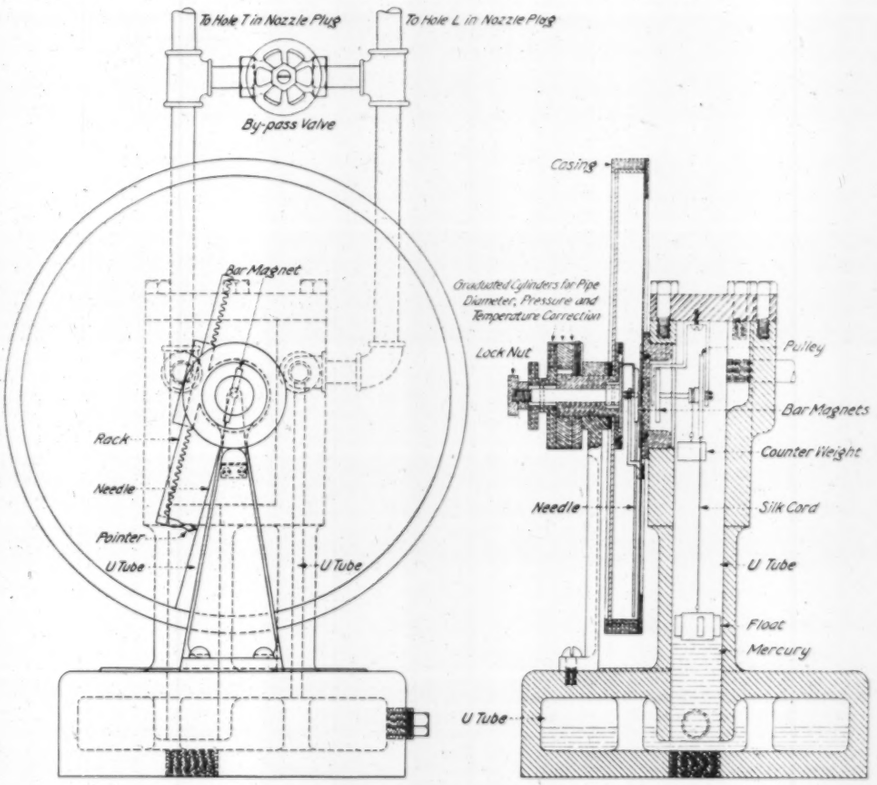

FIG. 3. ELEVATIONS AND SECTIONS OF AN INDICATING AIR OR STEAM FLOW METER.

One type of this indicating meter has been adopted for measuring air flow. The only changes from the steam type are (1) that water is substituted for mercury as the working liquid and (2) the dial curves show cubic feet of free air per minute per square inch of pipe area, under a temperature of 70° F.

It is stated that all these meters are adapted for steady flow conditions only and that the pitot nozzles must be placed in a straight run of pipe at least ten diameters from the preceding connection and two diameters from a following joint. The small iron pipes leading to the steam meters are filled with water and need to be given a slight slope throughout. As the air-meter connections have no water in them, this meter can be placed either above or below the pitot nozzle.

DAMAGE TO CONCRETE FROM SLAG is reported briefly by the German Reinforced-Concrete Commission in "Zentralblatt der Bauverwaltung" of June 15. A concrete sewer under a certain street was backfilled partly with sand and partly with iron slag. When after a few years the renewal of the pavement exposed the sewer, the part covered with slag was found badly attacked, so that extended repairs were necessary.

The Library of the New York Public Service Commission, First District.*

By ROBERT H. WHITTEN.†

The Public Service Commission for the First District has jurisdiction in New York City over gas and electric companies, railroads and street railroads, including under the Rapid Transit Act the laying out of rapid transit routes, the preparation and supervision of contracts for construction and operation, and in certain cases the granting of franchises. The surface, elevated and subway companies in New York City carry annually over 1,300,000,000 passengers, which exceeds by more than 66% the total number of passengers carried on the steam railroads of the entire country. The gas companies of the city produce more than 20% of the entire gas output of the United States.

The problems coming before the Commission in relation to rates, service, equipment and subway construction are numerous and important, and involve in many cases the working out of new methods and the laying down of policies of tremendous importance. The Commission has a staff of over 600 employes. About 300 of these are the engineers, draftsmen and inspectors engaged directly in the work of subway planning and construction. The Commission has drawn into its service highly trained statisticians, economists, accountants, lawyers and engineers of all kinds.

As a tool for the use of this large organization it has established an office library. The library is intended to be a working office collection of books, pamphlets and periodical articles needed in the current work of the Commission and in the consideration of the various questions that come before it. The library aims to collect and index material in such a thorough and scientific way that when information is wanted in relation to car brakes, gas meters, franchise terms, Paris subways, etc., the material from which the desired information may be secured will be at hand. The library now contains some 2,600 volumes and 5,400 pamphlets, making the total collection 8,000.

SELECTION AND COLLECTION OF MATERIAL.—In a special office library, great care must be taken in the selection and collection of material. Selection must be exhaustive but discriminating. All possible sources must be searched for useful material, but just as great care must be exercised to exclude material not needed. The efficiency of the collection is reduced by every useless book it contains. It is often a doubtful question as to whether a particular book should be added to the collection, and an even more troublesome question as to whether a book now on the shelves should be discarded. The librarian must use his best judgment. He will make mistakes both in original selection and in discarding, but it must be done.

In the library of the Public Service Commission we examine regularly the "Publisher's Weekly," and the lists of the United States and parliamentary publications. We get track of most of the books and pamphlets desired, however, by a rather careful perusal of a number of technical journals that relate to public utilities. Among the most important are "Electric Railway Journal," "Light Railway and Tramway Journal," "Electrical World," "Engineering News," "Progressive Age." Here we find references to the annual reports of the various public utility companies of American and European cities and to many printed papers and special reports, official or unofficial, relating to public utilities. The lists published by Stone & Webster and the current bibliographies in the "Journal of Political Economy," and "American Political Science Review" and the "Economic Quarterly" are also useful. Much material has been obtained by writing directly to the American consuls and to the public officers and company officials in the large cities of the world.

But as important as are the books, the pamphlets and special reports, they are outranked in value by the periodical article. In the numerous general, economic, law and technical periodicals of this and other countries there are many articles of the utmost importance in the routine work of the Commission, and in the consideration of the various problems that come before it. The library receives some 25 periodicals that are systematically examined, for articles and material of use to the Commission. In addition we examine the index to legal literature contained in the "Law Library Journal," the "Readers' Guide to Periodical Literature" and most important of all, the "Engineering Index." The "Engineering Index" is a monthly annotated index of the more important articles appearing in some 200 American and European technical journals. The publishers of the Index undertake to supply copies of the articles listed. This is a great convenience, especially in securing copies of articles in foreign periodicals. As soon as the Index is received it is checked up and an order sent in for copies of all the articles of special interest.

CLASSIFICATION.—A special library will usually require a special classification. The standard classifications are all right for the smaller public libraries. Standard classifications have been specially designed to meet the requirements of a general collection. They are usually a sad misfit when applied to a special library. The special working collection is intended to serve very definite needs and is required to answer certain definite problems. The purpose of the classification is to aid in supplying desired information with speed and certainty. The resources of the library must be classified around the special problems that are to be solved. "Close" classification is also essential. There should be a special heading or subheading in the classification for practically every subject, no matter how minute, concerning which information will be frequently wanted.

The classifications that we have worked out in the library of the Public Service Commission is extremely simple. The broad subjects are arranged alphabetically. Subheadings are arranged alphabetically under the main heading. States and countries are arranged alphabetically, and cities alphabetically under the state or country. The alphabet is much in evidence. The scheme has the advantage of fitting in well with an alphabetic catalogue.

A feature of the classification is the system of uniform interchangeable headings and subheadings. Certain subheadings are used uniformly under each of the main utility headings and certain main headings are used also as subheadings. Thus "Accidents" appears

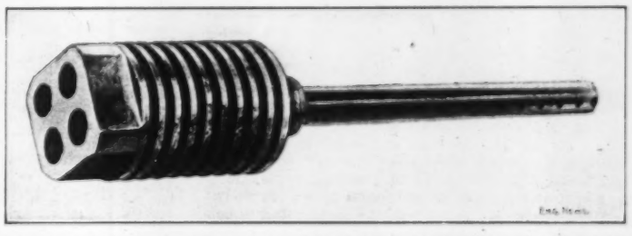

FIG. 4. PITOT-TUBE NOZZLE PLUG FOR MEASURING FLOW OF STEAM OR AIR.

*Reprinted from "Special Libraries" (State Library, Indianapolis, Ind.) for March, 1910.

†Librarian, New York Public Service Commission, First District, New York City.

as a main heading and also as a subheading under "Gas," "Electricity," "Transit," "Railroads," etc.

The notation used in the classification is a combination of letters and figures. Letters of the alphabet are used to represent all headings other than regional; e. g., Fr, Franchise; Ra, Railroad; Ga, Gas, etc. Regional headings are represented by Arabic numerals. States and countries are always designated by 2 figures and cities by 3 figures. These numbers are read as decimals, though the decimal point is uniformly omitted; e. g., 401 Boston follows 40 Massachusetts and precedes 41 Michigan. The same notation means the same thing wherever it occurs. Ac always means Accidents, whether as a main heading or as a subheading; e. g., Ac, Accidents; GaAc, Gas-Accidents; RaAc, Railroad-Accidents, etc. The same number is always used for a given city or country wherever it occurs in the classification; Ga401, Gas-Boston; Ra401, Railroads-Boston, etc.

The above are some of the main features of the classification. They are subject, however, to numerous elaborations, modifications and exceptions.

ARRANGEMENT OF MATERIAL.—All magazines, clippings and pamphlets are kept in large vertical file drawers. The clippings are usually placed in manila folders. They are arranged under exactly the same headings as the books on the shelves. Under each heading they are arranged chronologically according to year of publication. Each article or pamphlet has a separate file number, corresponding to the book number in the case of volumes on the shelves.

Of the 25 periodicals received, only 6 are bound. Articles of interest from periodicals that we do not bind are clipped, put in folders and placed in the vertical file drawers. The same treatment is also applied to the numerous special copies of periodicals not taken regularly, but which are purchased because they contain some article of interest. The vertical file drawers keep the material free from dust and offer a maximum of convenience in consultation. The material is compact and can be easily and quickly consulted.

CATALOGUE.—The card catalogue is in three main divisions, each alphabetically arranged: (1) Author and title; (2) subject headings; (3) regional headings.

The subject headings used in the classification are retained in the catalogue and used in their various combinations. Magazine articles and pamphlets are catalogued just as fully as books, and the cards for the articles are placed in the catalogue with the cards for the books. Chapters or parts of books relating to specific subjects are separately catalogued. A feature of the catalogue is the complete entry under the regional heading. Every subject entry relating to a particular city or country is duplicated under the city or country heading. We find it a great convenience to be able to find everything we have relating to Paris, for example, together under that heading.

We try to realize that it is not so much particular books or sets of books that we need to classify and index as it is the specific information contained in the books. Our catalogue is not used nearly so frequently to find the location of a particular book as it is to find information in regard to some particular subject. The more specialized a library becomes the more important, as well as practicable it becomes to classify and index information rather than books or sets of books.

BULLETINS AND PUBLICITY.—A library bulletin is issued once or twice a week containing references to current books, articles and pamphlets received by the library. Each bulletin is a single sheet. It is mimeographed and sent out to about 250 officers and employees of the Commission. The person receiving the bulletin checks in the margin the books or articles he desires to see, signs his name to the sheet and returns it to the library. On receipt of this sheet at the library, the book or article desired is sent if available, and if not, the name of the applicant is placed on a reserve list. Often it seems desirable to bring a particular article or book to the special attention of some officer or employe. To do this the item in question is stamped in red with a rubber stamp marked "special" on the copy sent to the particular person in question. An article or book that will probably be of interest to but one or two or three persons is omitted from the bulletin and is sent directly to the individuals interested with a blank form stating that it is being transmitted for inspection and the request to return as soon as possible. In these ways we attempt to carry out the recognized function of the office library, that of bringing promptly to the attention of the officers and employes of the Commission the new books and the articles of interest in connection with their official duties.

The bulletin is a notable success in directly increasing the use of the library. It also has a publicity feature. It is a constant reminder of the existence of the library and of the nature of the material that may be found there. The office library is an innovation and the habit of turning to it for information must be acquired. Various forms of publicity should be resorted to, to aid the development of the library habit. I think we could and should do more in this direction than we have in the past.

REFERENCE LISTS.—Numerous special reference lists are prepared from time to time on subjects of special interest. Our close classification, analytic catalogue entries and combined periodical and book catalogue make the preparation of special reference lists much simpler. Often all that is required is a straight copy of the catalogue entries.

BLUE PRINT METHODS.—We are experimenting on a new form of catalogue that promises certain distinct advantages. The catalogue entries on each subject are arranged chronologically and copied on letter size onion skin paper. This makes a negative from which a blue print may be taken. A single sheet or sheets being devoted to each subject, it is possible to add future accessions to the original sheet without the necessity of recopying. We can thus have always an up-to-date catalogue on loose sheets. It is of course easier to consult a catalogue with five to twenty entries on each page than to finger over the cards in a card catalogue. Another advantage will be that we can make portions of the catalogue available in the various bureaus of the Commission. Thus we can supply the Franchise bureau with a loose leaf always up-to-date catalogue of franchise material, the Bureau of Statistics and Accounts with a catalogue of accounts, finance and statistics, and similarly for the various other bureaus and departments. Another advantage will be that we can always supply a blue print copy of any part or parts of the catalogue. It seems probable that these will in large measure take the place of the special reference lists that we have been preparing. A reference list is out of date as soon as it is made. The advantage of having available an always up-to-date list is evident.

COLLECTION OF INFORMATION.—The library also compiles data on various subjects, and particularly in relation to public utility supervision and conditions in other states and cities. To a considerable extent, the qualifications essential for the scientific selection and collection of material are the same as those required for the compilation of the information contained in the material. These functions are therefore combined and the library, so far particularly as conditions in other states and cities are concerned, both collects and collates information. Thus detailed reports have been prepared in relation to the supervision of street railways in England and Prussia, the subway system of Paris and the laws and experience of various cities in relation to the indeterminate franchise and in relation to profit sharing as a method of franchise compensation. Numerous brief comparative statements have also been prepared. Much of our most valuable information has been drawn from the laws, methods and experience of the great cities of Europe.

I think that this combination of library work and collation or investigation is a practical one. The librarian gains an intimate knowledge of the contents of the material in his collection. His direct use of the material shows him the weak places in it and enables him to fill up the missing portions that are so absolutely essential to an efficient working collection. Active use of his collection helps the librarian, moreover, to get away from the habit of looking at the book as the unit of library work. It helps him to a realization that it is facts and information that it is his function to classify, arrange and make readily available rather than particular books or sets of books.

QUICK SERVICE.—The necessity for quick service is a fundamental and all sufficient reason for the existence of the special library. Information to be of use in the every-day work of the world must be quickly available. Quick service multiplies use—this is as true of libraries as it is of transit systems. The importance of quick service should therefore condition and mold the entire organization of the special or office library, its classification, arrangement and cataloguing.

In the development of a special library emphasis needs to be laid on these two things: First, the necessity for quick service, and second, that the service rendered is for the purpose of giving information and that the library is not merely dealing in copies or title of books and articles. While we hold these ideals in the library of which I am speaking, we still lack much of their complete realization.

Reconstructing a Defective Bridge Under Traffic.

The reconstruction of an arch bridge carrying the Creil and Amiens line of the Northern Ry. (of France) over a public road near Boves was carried out under heavy traffic in 1907. The bridge had a semi-circular span of 16.40 ft., and a height of 21 ft. from the road to the crown of the arch. It was built in 1845, but of late years the greatly increased weight of the rolling loads had caused the cracking and separation of the masonry. It was strengthened in 1903, but by 1906 the cracks began to spread to a dangerous extent. It was decided to remove the arch and replace it by a deck girder span. Owing to the extent of the traffic it was necessary to keep both tracks open during the work.

A concrete footing was built in front of each abutment, and upon these were erected posts to support a centering with solid lagging fitted tightly against the intrados of the arch. Four long columns on each side extended up through the arch, and carried caps, on which were laid four wide but shallow beams, one under each rail. Each beam was composed of 13 90-lb. 60-ft. rails (alternate rails being inverted), with two side plates held together by bolts above and below the rails (Fig. 1). These beams were set at such a height as to allow the new plate girders to be placed under them. Wooden blocks on each beam carried the rails. The beams extended beyond each end of the bridge to a crib pier of ties built in an excavation in the embankment, so that the load was carried clear of the roadbed and structure for the entire distance between the cribs.

The masonry arch was then removed, together with defective parts of the abutments and wing walls. The new brick masonry was then built to carry the abutments to the proper height for the girder span. This masonry was reinforced at its base (about the level of the springing line of the old arch) by five lines of steel rails, laid parallel with the face of the abutment and connected by tie rods. After some days, when the mortar had become set, a cribbing of ties was built on each abutment to support the temporary beams, so that the timber posts and the centering could be removed. This left everything clear for placing the new structure.

Falsework at each side of the bridge was erected for constructing half of the new deck structure (Fig. 2). This consisted of longitudinal girders (or I-beams) and a facia girder, with brick arches between the lower flanges, and a concrete filling to the top of the beams. With everything ready, the right-hand half of the bridge was first slid into place, the work being

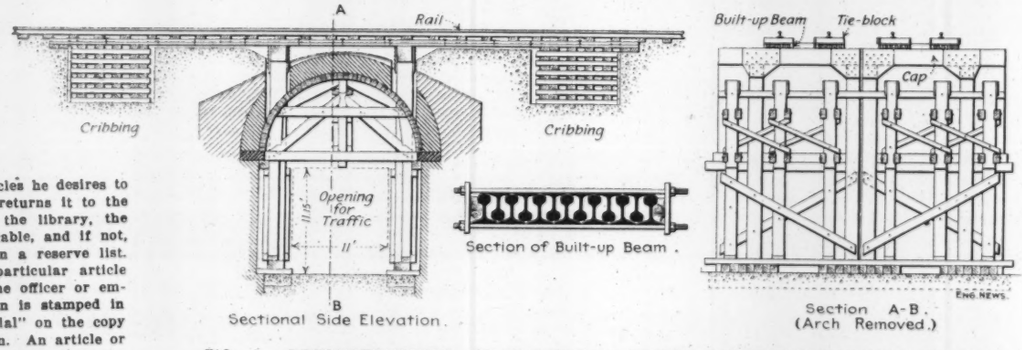

FIG. 1. RECONSTRUCTION OF THE BOVES BRIDGE, NORTHERN RAILWAY (FRANCE).
(This shows the falsework for removal of old arch and for supporting temporary beam spans to carry the track clear of the arch and roadbed.)

done at night in the intervals between trains. On the next night the other half was slid into place, completing the structure. Each operation occupied about three hours. In succeeding intervals between trains the temporary beams were removed, ballast laid, and the tracks restored to the ordinary construction.

During the actual replacement of the structure, trains were limited to a speed of 50 miles per hour, the regular maximum speed at this point being about 78 miles an hour. The work was commenced on Nov. 1, and completed on Dec. 18, 1907, but the slow orders were in force until Jan. 1, 1908. The work was done by two contractors, for the masonry and superstructure work respectively. The above description is condensed from an article in the January number of the "Revue Generale des Chemins de Fer," by Mr. M. H. Bouchard, Engineer of Maintenance of Way of the Northern Ry.

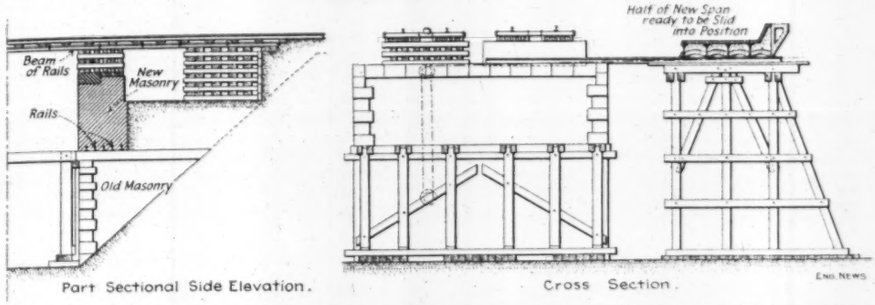

FIG. 2. RECONSTRUCTION OF THE BOVES BRIDGE, NORTHERN RAILWAY (FRANCE).
(This shows the new masonry abutments completed, and half of new superstructure ready to be slid laterally into position on the abutments.)

A 30-Year Record of Flow for the Columbia River.

A notable long-time record* of flow of the Columbia River, the second-largest stream system in the United States, is abstracted below, by courtesy of Mr. George Otis Smith, Director of the U. S. Geological Survey. The record, covering 30 years, 1879-1908 inclusive, was compiled by Mr. F. F. Henshaw, Assistant Engineer, and Mr. J. C. Stevens, District Engineer, of the Survey. The material used was:

(a) A record of gage-heights at Cascade Locks, Ore., by the Engineer Corps, U. S. Army, throughout the 30-yr. period.

(b) A record of gage-heights at The Dalles, Ore., by the U. S. Weather Bureau, since 1892.

(c) Two sets of discharge measurements, by the Engineer Corps in 1903, and by the Geological Survey in 1907 and 1908.

The Columbia River record is summarized in two tables appended hereto.

The drainage area of the Columbia River at The Dalles is about 237,000 sq. mi. in extent. The only important tributaries of the Columbia, between this point and the upper reaches of tidewater below Cascade Locks, are the Hood, Klickitat, and White Salmon rivers. The observations at The Dalles cover 99% of the total drainage area of the Columbia east of the Cascade Mountain, and the records may, therefore, be fairly accepted as representative of the portion of the basin lying in the arid region.

As the tables show, the *maximum* flood (in June, 1894,) amounted to 1,390,000 cu. ft. per sec. The second highest flow was 1,130,000 cu. ft. per sec. (in July, 1880). Flows over 1,000,000 cu. ft. per sec. were reached in 1882 and 1887.

The *lowest* flow recorded (in January, 1888,) was equivalent to 48,500 cu. ft. per sec.; holding back of water by ice gorges above was probably responsible for this minimum. The average flow of the lowest day in each year for the entire period is 66,600 cu. ft. per sec., and for the lowest month in each year 78,700 cu. ft. per sec.

The highest total discharge for an entire year at The Dalles (1894) was 244,000,000 acre-feet, the lowest (1889), was 94,200,000 acre-feet. The average annual discharge for the entire 30-yr. period was 170,000,000 acre-feet, equivalent to a depth of 13.48 ins. over the entire drainage area.

Although the variations in the above amounts are considerable, yet they do not represent wide fluctuations when compared with many of the other large streams of the United States, especially those in the West. The highest year, 1894, was attended by a discharge of only 43% in excess of the mean for the entire period, while the lowest year, 1889, was only 44.7% less than the same mean. All of which indicates that the Columbia River is comparatively steady in its discharge, considering the size of the basin and its diversified character.

The discharge for the high-water periods, embracing a large part of the total yearly run-off, is based on measurements which were made with surface floats. The relation of the surface velocities, thereby obtained, to the mean velocity of the entire section was established by a series of vertical velocity curves made with the large Price current meter held on piano wire. A small cable was thrown across the channel, fastened on the waters' edge on each bank and allowed to sag below the surface just sufficient to permit the passage of steamers. The cable was tagged at 10-ft. intervals. It served to hold a small boat from which the meter was operated, taking velocities at all points in the vertical sections.

This involved the use of the meter at the maximum depth of nearly 90 ft., which is believed to be the deepest current-meter measurement yet recorded.

An interesting point was developed relative to the shape of the vertical curve in these deep sections: The greater part of the curve is nearly vertical, curving in the familiar way only near the top and bottom, where lower velocities were encountered. This fact would indicate that in rivers of great depth there is practical uniformity in the vertical velocity except at the extremes of the section, making the position of the thread of mean velocity indeterminate.

*In Water Supply Paper No. 252 of the U. S. Geological Survey, containing records of stream-flow for the Columbia River basin and for smaller streams along the North Pacific Coast.

TABLE II.—MEAN DISCHARGE OF COLUMBIA RIVER AT THE DALLES, ORE., FOR SUCCESSIVE TEN-YEAR PERIODS.

Period.	Yearly means. Sec.-feet.	Variation from 30-year mean. Per cent.	Means of minimum months. Sec.-feet.	Variation from 30-year mean.
1879-1888	264,000	+12.3	80,400	+ 2.2
1880-1889	247,000	+ 5.1	79,200	+ .6
1881-1890	236,000	+ 0.4	76,200	— 3.2
1882-1891	222,000	— 5.5	72,600	— 7.8
1883-1892	215,000	— 8.5	72,300	— 8.1
1884-1893	215,000	— 8.5	71,000	— 9.8
1885-1894	224,000	— 4.7	74,000	— 6.0
1886-1895	221,000	— 6.0	72,300	— 8.1
1887-1896	225,000	— 4.3	74,400	— 5.5
1888-1897	222,000	— 5.5	76,500	— 2.8
1889-1898	224,000	— 4.7	75,300	— 4.3
1890-1899	238,000	+ 1.3	78,800	+ .1
1891-1900	240,000	+ 2.1	84,600	+ 7.4
1892-1901	245,000	+ 4.3	86,700	+10.2
1893-1902	245,000	+ 4.3	87,700	+11.4
1894-1903	244,000	+ 3.8	89,300	+13.5
1895-1904	234,000	— 0.4	85,300	+ 8.4
1896-1905	230,000	— 2.1	84,100	+ 6.9
1897-1906	221,000	— 6.0	81,400	+ 3.4
1898-1907	219,000	— 6.8	80,600	+ 2.4
1899-1908	216,000	— 8.1	80,400	+ 2.2
1879-1908	235,000	.....	78,700	.....

The Construction of Sand-Clay Roads in Western Kansas.*

By W. S. GEARHART.†

In the shifting sand hills of western Kansas sand-clay, sand-gypsum or sand-gumbo roads can be and are being constructed at a very reasonable cost and they are proving highly satisfactory. There is perhaps no road so wretched as one of these deep shifting sand hill roads and unless one has been unfortunate enough to have had to drive or walk through (not over) one of them, no conception can be formed of such a task.

The resistance per ton on a level dry deep sand road is equal to or greater than that on a hard dry earth road on a 12% grade.

A sand road is best when it is wet and worst when it is dry. With the clay and gumbo road we have just the reverse order and when these materials occur in nature in such proportions that the clay or gumbo just fills the voids in the sand and acts as a binder it overcomes the objection in both materials and we have what are called natural sand-clay or sand-gumbo roads which can be found in many communities.

The sand-clay road has been carefully studied and several hundred miles of this type of construction have been built in the Atlantic and Gulf states and probably 75 miles in Kansas, which has proven very satisfactory. This type of road is adapted to moderate traffic.

In the construction of a sand-clay road it is a difficult problem to select a proper clay for the binding material. Laboratory tests will assist in determining what to expect from different clays but it is much better

*From an address delivered before the Missouri Highway Engineers' Association, Kansas City, Mo., Feb. 8, 1910.

†Professor of Highway Engineering, Kansas State Agricultural College, Manhattan, Kan.

TABLE I.—THIRTY-YEAR DISCHARGE RECORD FOR THE COLUMBIA RIVER AT THE DALLES, OREGON.

[Drainage area, 237,000 square miles.]

Year.	Discharge in second-feet. Maximum.	Minimum.	Highest monthly mean.	Lowest monthly mean.	Mean.	Mean per square mile.	Run-off. Depth in inches.	Acre-feet.	Per cent. variation from mean.
1879	789,000	65,600	751,000	73,300	295,000	1.24	16.94	214,000,000	+25.6
1880	1,130,000	74,400	973,000	83,400	322,000	1.36	18.54	234,000,000	+37.0
1881	742,000	87,600	686,000	97,000	309,000	1.31	17.70	224,000,000	+31.5
1882	1,090,000	67,400	947,000	74,900	281,000	1.19	16.13	204,000,000	+19.6
1883	704,000	65,600	657,000	82,500	245,000	1.04	14.10	178,000,000	+ 4.3
1884	795,000	50,300	736,000	80,400	248,000	1.05	14.27	180,000,000	+ 5.5
1885	541,000	73,400	497,000	91,000	222,000	.937	12.72	161,000,000	— 5.5
1886	765,000	60,800	653,000	68,200	214,000	.902	12.23	155,000,000	— 8.9
1887	1,040,000	64,700	932,000	73,900	289,000	1.22	16.60	210,000,000	+23.0
1888	636,000	48,500	579,000	79,000	210,000	.885	12.05	152,000,000	—10.6
1889	326,000	53,900	283,000	61,900	130,000	.548	7.46	94,200,000	—44.7
1890	719,000	50,300	631,000	53,000	208,000	.878	11.97	151,000,000	—11.5
1891	502,000	56,600	468,000	61,400	178,000	.749	10.19	129,000,000	—24.2
1892	688,000	64,800	615,000	71,500	208,000	.878	11.99	152,000,000	—11.5
1893	774,000	62,000	678,000	69,500	246,000	1.04	14.14	179,000,000	+ 4.7
1894	1,390,000	86,400	1,140,000	111,000	336,000	1.42	19.27	244,000,000	+43.0
1895	535,000	68,400	423,000	73,700	191,000	.806	10.99	139,000,000	—18.7
1896	900,000	68,400	774,000	88,700	257,000	1.08	14.76	187,000,000	+ 9.4
1897	895,000	80,600	710,000	95,300	255,000	1.08	14.70	186,000,000	+ 8.5
1898	737,000	57,200	684,000	67,400	236,000	.998	13.56	171,000,000	+ 0.4
1899	903,000	69,800	726,000	96,200	267,000	1.13	15.32	194,000,000	+13.6
1900	619,000	97,000	505,000	111,000	231,000	.974	13.26	167,000,000	— 1.7
1901	753,000	75,400	583,000	82,400	220,000	.929	12.64	160,000,000	— 6.4
1902	732,000	57,200	607,000	82,100	208,000	.879	11.95	151,000,000	—11.5
1903	903,000	72,200	779,000	85,900	236,000	.998	13.56	172,000,000	+ 0.4
1904	714,000	64,800	633,000	70,200	244,000	1.03	13.99	177,000,000	+ 3.8
1905	462,000	61,400	394,000	61,700	144,000	.607	8.25	104,000,000	—38.7
1906	415,000	58,400	363,000	62,300	170,000	.716	9.76	123,000,000	—27.6
1907	666,000	76,200	601,000	86,800	238,000	1.00	13.62	172,000,000	+ 1.3
1908	743,000	59,000	607,000	65,000	205,000	.867	11.82	149,000,000	—12.8
Mean	754,000	66,600	654,000	78,700	235,000	.991	13.48	170,000,000	.....

to check your laboratory test by building only a few miles of road at a time until you have a chance to see the practical test demonstrate the worth of the clay. The properties of clay, which are of the greatest importance in road construction, are plasticity and the property of slaking when they first become wet after having been uncovered. The most plastic of these materials are technically called "ball clays." A lump of such clay immersed in water will usually preserve its form a long time.

Non-slaking clays, although they are very sticky when wet, generally readily mix with water. There are other clays, however, which will immediately fall to pieces when immersed, as a lump of quicklime will do. This is due to the rapid absorption of water in the porous structure of the clay. These are known as slaking clay and are more easily mixed with other materials than the more plastic ball clays, and this is of course to their advantage for road building but, on the other hand, they often have inferior binding powers.

There is still another physical characteristic of clay of great importance in the construction of roads. Many clays shrink when dry. This shrinkage is the measure of their expansion and expansion renders the sand-clay mixture unstable. When water removed by evaporation is restored to the sand-clay mixture, its entrance is accompanied by a simultaneous expansion which separates the grains of sand. This property is inherent in the clay and cannot be overcome except that by using less clay its destructive action can be modified in a measure. The best kind of clay for this construction is one which slakes sufficiently easily to enable the lumps to be readily broken up and which, at the same time without being too plastic, has sufficient binding power to cement the grains of sand and form a smooth impervious road surface.

The available materials should also be tested in order to secure a clay having the least possible shrinkage. The best method is to examine the roads in which this material is found. The best wearing surface of the sand-clay road is obtained when the voids in the sand are entirely filled with a good binding clay. Any excess of clay above the amount required to fill the voids in the sand is a detriment.

In constructing a sand-clay road on a sandy subsoil, adequate permanent drainage should be provided and the road well crowned. Shoulders should be thrown up to confine the clay as it is deposited. The work should begin at the end of the road nearest the supply of clay and the clay deposited in layers from 6 to 12 ins. deep and from 10 to 18 ft. wide, depending upon the volume and kind of traffic to be carried. The large lumps should be broken up while dry and the whole surface smoothed up and 2 to 4 ins. of sand placed on top. The sand and the clay should then be thoroughly mixed and puddled with water by plowing and harrowing with a disk harrow. If the water is not available it is well to wait until after a prolonged rain to do the mixing and puddling. Dry mixing has generally been unsuccessful.

If sufficient funds are not available to do the mixing and puddling by machinery it may be left for the traffic to do it. If this method is followed a muddy road will result for some time, however, and it will require probably two years to get the road in good condition. When the clay balls, add more sand and if the surface loosens during the dry weather add more clay; or better, use a clay with good binding power.

A first-class sand-clay road on a clay subsoil can be constructed in the following manner: After the road has been graded and properly crowned and ample drainage provided, 4 ins. of the surface for the width to be treated should be pulverized by plowing and disking and then a layer of sand 6 to 8 ins. deep placed upon it and the sand and clay thoroughly mixed comparatively dry by plowing and harrowing. After a prolonged rain puddle the road with a harrow and shape it up well while wet. Stop the traffic if necessary until the surface has become dry, but the road should be thrown open to use as soon as practicable. No sand-clay road is in proper condition when first constructed and it will require careful attention for two years. It should be dragged after every rain.

The sand-clay road is more resilient than an ordinary macadam road and generally costs less to construct and maintain than any other except an earth road.

To the idler, clay is refuse; to the potter, opportunity; to the farmer in and beyond the sand hills, it is his salvation as evidenced by the following examples:

So far as I have been able to learn, the first sand-gypsum road in Kansas was constructed in 1892 near Kinsley, Edwards Co., by John DeMain. In this county gypsum is found in large quantities in the flats and sand-hill beds. Its composition is about 1 part of gypsum to from 3 to 5 parts sand. In appearance it resembles a sand-lime mortar of the same proportions. In some of the beds large deposits of gravel are found with the gypsum which add very much to its road-making value.

In 1892, five miles of sand-clay road were constructed; in 1898, five miles; in 1902, five miles; and since that time ten miles more have been completed, making a total of 25 miles. These roads were all built 16 ft. wide. The gypsum was placed 8 ins. deep in the middle and about 6 ins. at the sides. The average haul of the gypsum was one-half mile; $3 per eight-hour day was paid for teams. The traffic was left to do the mixing and the cost has been $350 per mile or 3.72 cts. per sq. yd. The cost of maintenance with a King drag is $10 per mile per year. For the original construction there was no doubt a large amount of labor donated which is not reported. Before the roads were treated fifty bushels of wheat was the maximum load for four horses. Now one hundred bushels can be hauled with ease. I was recently over these roads in an automobile and in a good many places the cyclometer registered forty miles per hour.

In 1905 and 1906 4½ miles of sand-gypsum road was constructed south of Syracuse in Hamilton County. This road is 16 ft. wide and the gypsum was placed 8 ins. deep; $3.50 per day was paid for teams and the average haul was three miles. The traffic did the mixing of the sand and gypsum and the cost was $500 per mile or 5.3 cts. per sq. yd. The cost of maintenance with the King drag is $5.50 per mile per year. On account of the long haul and the low cost I believe there must have been considerable labor donated, but none is reported. In dry weather the surface grinds up some and blows away. From my observations of the sand-gypsum roads I believe that this trouble can be overcome by treating the surface with a good grade of road oil.

Immediately after a rain the road is a little slippery and this can practically be eliminated by placing a little sand on the surface. A thousand pounds was a big load over this sand road before it was improved, but now three thousand pounds is a very ordinary load. Before the road was built the land beyond the sand hills sold for $1 per acre, and less. Now it is selling for from $8 to $10 per acre. The road has been a great thing for Syracuse for it opened up a new market for the four southwest counties of Kansas and a large area in Colorado. It is a common sight to see twenty wagons in line on the road loaded with broom corn.

During the summer of 1906, Prof. Albert Dickens, of the Kansas State Agricultural College, oiled one mile of very bad sand road in Finney County, south of Garden City. The amount of oil required varied from 3.7 to 6.06 gals. per sq. yd. This road has proven very satisfactory, even though it has been sadly neglected.

In 1909 five miles of sand-gypsum road was constructed, two miles on the north end and three miles on the south end of the oiled road. On the north end a very heavy clay was used which contained about 20% of gypsum and 15% of gravel and it has made a very fine road. The south end of the road was constructed with what is called gypsum, but it is really a silt very much like the Arkansas River sediment. It lacks binder and is mushy when wet and blows away when dry. The following is a summary of the cost of the roads for the different miles:

	Width, ft.	Depth of gypsum, ins.	Average, haul, miles.	Cost per sq. yd., cts.	Cost per mile.
1st mile	12	8	1¼	7.2	$510
2nd mile	8	10	1¼	18.72	880
3rd mile, oiled	18	...	...	11 to 19	1,480
4th mile	8	10	2½	37.45	1,760
5th mile	8	10	...	18.72	880
6th mile	8	10	...	15.00	704

The road was left for the traffic to mix the materials and $50 per mile has been spent in dragging, shaping up and repairing the weak spots. The road is dragged after every rain and high wind. A 6,000-lb. load on a wagon with 2-in. tires is often seen on this road. It used to be a three-hour's drive over these six miles with two horses in a buggy. The only complaint the farmers have against this road now is that they have to get locks for their wagons to get down the hills. Some of the farmers who have no locks drive with two wheels on the hard road and the other two in the sand. The land south of these hills has very materially increased in value since the road was completed. The farmers ten miles south of the hills hauled their produce forty miles to Arkalon before the sand road was improved and now Garden City is receiving the trade from twenty-eight miles south.

In October, 1908, Mr. W. L. Spoon, Superintendent of Road Construction, Office Public Roads, built two miles of sand-clay road in Ford Co., south of Dodge City. The building material was obtained from a silt deposit in an old irrigation canal near the road. The longest haul did not exceed one mile. The road is 14 ft. wide and the binder 12 ins. deep in the center and 8 ins. at the sides. About 4 ins. of sand was placed on top of the clay and, as in the Garden City construction, the traffic did the mixing. The cost was $880 per mile or 10.7 cts. per sq. yd. This does not include about $250 spent in cutting down hills. The maintenance per year per mile with the King drag has been $6.30. Before this road was improved the sand was so deep that an empty wagon was a load for two horses. Now it is in first-class condition and the land has advanced 25% in value. I inspected this road last winter during the prolonged rain and found it in good condition.

Upon the completion of the Dodge City work, Mr. Spoon went to Bucklin, in the same county, and constructed about two miles of sand-clay road. The road is 14 ft. wide and the binding material used was a yellow clay placed on the road 12 ins. deep in the middle and 8 ins. at the sides. The longest haul did not exceed 1¼ miles.

The cost per mile was $920, or 11.2 cts. per sq. yd. This does not include about $200 spent in cutting down hills. The cost of maintenance has been $12 per mile per year for dragging with a King drag. Twenty bushels of wheat used to be a big load for a team on this road and now sixty-five bushels can be hauled more easily than twenty bushels before. The farmers are well pleased with their investment.

At Ashland, Clark Co., along the Cimarron River, there was four miles of sand road which was one of the worst stretches of road in the state. This sand was so fine and there was so much of it that in a dry time it was a heavy drag for a team with an empty wagon and to get through it at all with a load necessitated not less than four hours and the journey had to be made by very slow stages and the horses rested every few hundred yards. A toll road company was incorporated a number of years ago with a capital of $5,000 to construct a sand-clay road through these sand hills. A good quality of clay was found at distances ranging from a hundred yards to a mile from the work. The road was well crowned and from 8 to 10 ins. of clay placed upon it and well dragged down. The weather was very dry during the construction and for some time trouble was experienced with chuck holes cutting through the clay, but after the first good rain no further trouble was experienced.

The road is maintained by collecting tolls of 5 cts. per mile for automobiles, 2¾ cts. per mile for wagons, 2 cts. per mile for light vehicles and 2 cts. per mile for cattle per head. A man and team is constantly employed to drag and refill the worn places and collect the tolls. After every rain the road is dragged with a King drag one or more times which keeps the surface smooth and the road well crowned.

The work of preparing the roadbed, hauling and distributing the clay and putting the road in good condition costs from $800 to $1,000 per mile. A great deal more than this per mile has been spent for bridges, toll house, tools and other accessories, but the traffic is heavy and the tolls collected not only pay the expenses of upkeep and maintenance, but will ultimately reimburse the company for the outlay in first cost.

This is an excellent example of what the people are willing to pay for good roads and the privilege to drive upon them. Suppose there is an average of only five automobiles, fifteen wagons, and ten light vehicles per day passes over each mile going to and from Ashland. This will give an income of $1.72 per day and, if the Sundays are omitted, there will be an annual income of $538 per mile. Deducting $300 for maintenance there is $238 left, which is 5% interest on $4,767, or probably 15% on the actual investment. I believe the assumed traffic is very much below rather than above the actual.

For the information concerning the different roads I am indebted to Messrs. P. A. Pierson, of Kinsley; Vic L. Harris, of Syracuse; D. D. Doty, of Garden City; P. H. Sughrue, of Dodge City; W. C. Duncker, of Bucklin; and W. J. Berryman, of Ashland.

The Annual Convention of the American Society of Civil Engineers.

The 42d annual convention, held at Chicago June 21 to 24, was a distinct success as a social gathering of the members, but as a meeting for the consideration of professional subjects its importance was a negligible quantity. For several years past it has been the professed policy to subordinate the technical to the social side at the summer meeting, although strong protest has been made to such a policy; but as a rule there have been some important papers or subjects for discussion. The Chicago meeting of 1910, however, represented probably the carrying of this policy to an "irreducible minimum." This will be evident when it is said that a convention occupying four entire days (and an informal evening reception in addition) had only one short session devoted to business, and that the matters then considered were mainly of a routine character.

It is true that the technical side was rounded out a little by three interesting illustrated talks at evening sessions; one on the New York tunnel extension of the Pennsylvania Ry., by Mr. Alfred Noble; one on the new water-supply system for New York, by Mr. J. Waldo Smith; and a third on the plans proposed for the beautifying of Chicago.

The proceedings of the business session can be recorded in a short space. The meeting was held June 21 at the Congress Hotel. An address of wel-

come was delivered by Dr. Wm. A. Evans, the city Health Commissioner, who referred to the necessity of planning engineering and public work for the future rather than for the present, and to the important relation of engineering (and the engineer) to matters of public health and sanitation. The President, Mr. John A. Bensel (New York) then delivered the annual address, an abstract of which is given elsewhere in this issue. A brief report from the Board of Directors was presented, which was unfavorable to the proposed appointment of a committee on the preservation of wood. There was very little discussion, but Mr. S. A. Whinery pointed out that the committee would have no power to make original investigations, and that, while several new or modified processes are now in use, nothing can be said definitely as to their value until this has been demonstrated by several years of experience. The general opinion seemed to be that no good purpose could be served by appointing such a committee, and a motion recommending that the Board of Direction should submit the matter to letter ballot was voted down.

The time and place for the next meeting was then taken up for consideration and afforded the usual touch of comedy to the proceedings. The inevitable long and varied list of individual suggestions was read, though there seems to be no reason why time should be spent in this way. After a few desultory remarks it was voted (as usual) to refer the matter to the Board of Direction, an amendment recommending that the meeting should be held in some large city being voted down.

A brief report from the Committee on Rail Sections was read, stating that the committee had nothing to add to its former reports and recommending that it be discharged. The report was accepted. A report of the Committee on the Licensing of Civil Engineers was read, and an abstract of this is given elsewhere in this issue. There was a brief discussion, in which Mr. Whinery expressed doubt as to whether any legislation could be made to cover satisfactorily all branches of the profession or to apply effectively to one branch; he suggested that the Society should adopt a code of ethics for the government of its own members before asking any state legislative to interfere. On motion, however, it was voted to endorse the recommendation of the committee that the Board of Direction should be empowered to take up this matter with the proper authorities from time to time.

The really important feature of the convention was in the series of excursions and entertainments, with the opportunities for social intercourse which these afforded. On June 21, there was an automobile trip of over 40 miles through the city's boulevards and parks. June 22 was given over to a trip by steamer to the great steel works at Gary, Ind., a train of gondola cars being provided to convey the party through the mills and around the works. A small number went out to the water-works plant. The day was excessively hot, so that all enjoyed the cool breezes of the lake trip. The large steamer "United States" was engaged for the exclusive use of the party. On June 23, there was an excursion to the drainage canal and its power plant; other excursions were made to the new passenger terminal of the Chicago & Northwestern Ry., the Fisk St. power station of the Commonwealth Edison Co., and the mail-order establishment the Sears-Roebuck Co., which occupies a group of large buildings in the outskirts of the city and has some 8,500 employees. Lunch was served at this plant, which has five restaurants of its own, there being no adequate lunch-room accommodations in the neighborhood. On June 24, there was a trip by special train on the Chicago & Northwestern Ry. to the U. S. army post at Fort Sheridan, and the new U. S. naval training station at Lake Bluff. Lunch was served on the train, and from Lake Bluff the train conveyed the party to Ravinia Park, a pleasure resort which was open only to the Society. Here dinner was served and there was an orchestral concert.

The registered attendance at the convention was about 500. The members numbered 287 and of these 130 were from Chicago.

Annual Convention of the American Railway Master Mechanics' Association.

Following the convention of the Master Car Builders' Association, reported in our issue of last week, and in connection with the same admirable exhibit of railway machinery on the Million Dollar Pier, the American Railway Master Mechanics' Association held its 43d annual convention on June 21-23 at Atlantic City, N. J. The distinguishing features of this year's meeting were the very large attendance and the increased interest in the proceedings as manifested by the very free discussion on the floor.

Nearly 400 members of the society were registered and from the crowded condition of the meeting hall, which in the past three years has been amply large for the attendance, it seems probable that the greater majority of members registered, as well as a number of their guests, were present at each of the three meetings. The desire of the members to enter into the discussion of the papers and reports was perhaps more marked on account of its contrast to the conditions observed at the meeting of the sister organization the week before, when the discussion was very limited.

In these associations, as in nearly every other working technical society, the greater part of the work done is by committees, whose personnel is made up of men especially fitted for the special work in hand, and the reports of these committees is referred to a letter ballot of the society for approval by the majority vote of the members present at the annual convention. It is a matter of experience that once a report has passed the vote of the convention it is quite sure to pass the letter ballot of the Association, either on account of a routine examination of the matter by the members voting at the later letter ballot or because these same members think that the members in convention assembled would not have passed the report had there been anything wrong with it. It is, therefore, obvious that the responsibility for the acceptance of reports is largely upon the convention, and that full discussion of these reports upon the floor is eminently desirable. In this respect the recent meeting of the Master Mechanics' Association is much to be commended.

The question of consolidation with the Master Car Builders' Association, so thoroughly discussed by that Association in its convention last week, was not entered into on the floor of the Master Mechanics' Association. The joint committee report was accepted and the matter referred to the executive committee for consideration during the coming year.

President's Address.

The address of the President, Mr. G. W. Wildin, Mechanical Superintendent, N. Y., N. H. & H. R. R., contained two very important suggestions: (1) that the Association establish a permanent technical bureau for the purpose of experimentation and investigation; (2) that the members become more of one opinion upon technical matters likely to be the subject of legislative action and that they express that opinion so definitely that the legislative authorities will have to take cognizance of it. Mr. Wildin's discussion of these points, in part, was as follows:

I wish to advocate for your most serious consideration the establishment of a permanent centralized technical bureau within our association to be composed of active members of the association having strong technical and practical training, and to have associated with them the officers of the association as members ex-officio. This body should be clothed with authority to act for the association on all important questions arising in the interim between our annual meetings, making a full report to the association in convention assembled at the first opportunity.

I would further suggest for your consideration that one member of this bureau be a salaried incumbent, the permanency of the office and the emoluments to be such as to permit of its acceptance by an individual fully equipped through experience and training to cope with any and all questions demanding his attention, and who will at all times keep the central body well posted as to the general happenings of interest throughout the country, collect such data as may be required by the body and direct such investigations and research work as may be assigned to him.

. . . . . .

It is also quite necessary that we as an association be more of a unanimous mind on questions that are likely to call for or be made the subject of either Federal or state legislation. Such questions should be anticipated and acted upon as far in advance as possible, and then when real legislative action is begun a precedence will have been established, so that the dominating and impelling forces which shape the opinions and recommendations of legislative committees will not emanate from the leader of some political clan or labor organization, but will be found recorded in our proceedings and practices as the crystalized judgment of the members of this great engineering body, whose opinion cannot long be ignored.

Papers and Committee Reports.

MECHANICAL STOKERS.—The committee on this subject referred briefly to a few mechanical stokers which have come into experimental use since last year and commented upon the progress of those stokers previously noted. The conclusion of the report is as follows:

Our experience has developed that the stoker is not mechanically perfect. Therefore, it requires considerable skill and care on the part of the engineman to avoid failures. The stoker company have made several improvements in the design of the machine in the past year, and, in view of the improvements that have been made that have so materially improved its performance, it is reasonable to assume that this machine will yet prove a successful device for automatic firing of locomotives.

It could hardly be expected that mechanical stokers at the present stage of development could show an economy over hand firing by an expert fireman, but it is considered that, if economy is expected, it must be looked for in the comparison with the average of all grades of firemen in regular service. Designers of the present day are more interested in effecting practicability and security against failure rather than the promoting efficiency by its use, as this effect is more or less taken for granted with any properly designed and thoroughly practical stoker.

The main defect of the present stokers seems to be, to a very great extent, with the coal-conveying apparatus, and it is the failure of this particular feature which usually makes the stokers of to-day somewhat unreliable.

Your committee considers the progress and the development of the mechanical stokers during the past years as indicative of a determined effort to build stokers which will be in every way a success, and is convinced that the mechanical stoker is destined to be a very important factor in the operation of heavy locomotives in the not very distant future.

In the discussion that followed the report several members described the stokers in operation on their respective roads. Although these stokers are of different types, a favorable opinion was, with one exception, expressed of each one. In particular the Crawford stoker now in experimental use on the Pennsylvania Lines and the Street stoker on the Lake Shore were highly commended. The leading feature noted in the former is the absence of smoke on locomotives fired by it, a desirable feature in view of the anti-smoke campaign in many of our cities. So far the railway using it is not prepared to make any statement as to its mechanical and economic operation, although its design is given in drawings in the report. The Street stoker on the Lake Shore was warmly praised by Mr. Franey, of that road, for its ease in firing and the saving in coal. The inventor has not attempted any smoke-preventing feature as yet.

FUEL ECONOMIES.—An individual paper entitled "Education as an Essential of Fuel Economy" was read by Mr. W. C. Hayes, Supt. Locomotive Operation, Erie R. R. Mr. Hayes in the discussion on mechanical stokers expressed the opinion that if as much time and energy were put on the education of firemen as has been put on the development of the mechanical stoker the firing of locomotives would be benefited to an equal degree. These ideas were amplified in the paper read later in the day. Mr. Hayes recommended that there be an improvement in the method of selecting firemen, that instead of the old method of taking any man that looked fit and trusting that he might be made an efficient workman, some preliminary knowledge should be required. In this connection, a correspondence school for firemen, recently started, was strongly recommended. After a fireman has been selected, he should be competently supervised and instructed by a road foreman who has time to devote to each man, and finally he should be made to pass successive examinations in order to be retained or promoted to an engineer.

EDUCATION OF APPRENTICES AND OTHER EMPLOYEES.—Somewhat along the same line as the above paper by Mr. Hayes was the topical discussion, headed by Mr. F. W. Thomas, Supt. of Apprentices, A. T. & S. F. Ry., upon "Apprenticeship Education." Mr. Thomas outlined to some extent the desirable features of an apprentice school and then described the methods in force in the highly successful school on his road. The main points

that he brought out were that the boys should be made to do useful work in the shop along with their general study and instruction and that the instructor should be a sympathetic man whom the boys would respect and admire. Representatives of the New York Central Lines and of the Union Pacific both testified to the admirable results being achieved in the apprentice schools on their roads.

LOCOMOTIVE BOILER ACCIDENTS.—The Committee on Design, Construction and Inspection of Locomotive Boilers presented a report giving the results of an investigation into the causes of locomotive boiler explosions in the United States. This report is published on another page of this issue. In the present Federal Congress there has been introduced a bill known as the Federal Boiler Inspection Bill which in the words of President Wildin "has created quite a furore and not a little anxiety among railway managers throughout the country." In the investigations in the study of this bill representations have been made to the Committees of the House and Senate that a vast number of the locomotive boiler explosions have been due to poor equipment rather than the fault of the enginemen, who are often blamed by the authorities of the railway. These representations are not upheld by the report of the committee, for the data taken from 157 railways show that over 90% of the accidents is the last four years have been due to low water in the boiler, a condition no inspection could control.

SELF-DUMPING ASH-PANS.—A topical discussion on this subject showed that the federal requirement that self-dumping ash-pans be installed on all locomotives has been the cause of great trouble to the railways. As far as was brought out in the discussion no railway has as yet developed this device to a working basis and the experimental pans that have been built are anything but satisfactory. They freeze up, scatter fire along the road and warp under heat.

SUPERHEATERS ON LOCOMOTIVES.—There were two lengthy papers on this subject, one the report of the Committee on Superheaters and the other an individual paper by Profs. C. H. Benjamin and Louis E. Endsley, entitled "Locomotive Performance Under Different Degrees of Superheated Steam." The first of these is a most exhaustive description of the various superheaters used on the railways of the world, mainly upon those in the United States and Canada. In general, 20 American roads reported having 805 locomotives equipped with superheaters and 34 roads reported no locomotives so equipped. In Europe about 130 railways are using superheaters of one type. In America the railways report eight different types and in the committee report seven of these are described and illustrated and figures are given stating the loss or gain in efficiency and cost noted in using the superheater. The report is quite complete and contains much valuable information.

The paper by Profs. Benjamin and Endsley is in continuation of the similar paper presented last year to this association by Prof. Goss. That paper compared the performances of a locomotive under saturated and superheated steam, respectively. The later paper compares these same two performances with those of the same locomotive under carying degrees of superheat. From the test the conclusions are that when superheated steam is used pressures of more than 200 lbs. are uneconomical, that within the limits of superheat observed (about 110° to 180° F.) the steam and coal consumption diminish as the superheat increases, and that further experiments with a higher degree of superheat are desirable, in order to determine the economical limit of superheating.

In the discussion three things were made prominent: The superheat on a locomotive increases its efficiency; the higher the superheat the higher the efficiency to be expected; the piston valve is superior to the slide valve in a superheated steam locomotive.

LOCOMOTIVE SAFETY VALVES.—A Committee on Size and Capacity of Safety Valves for Use on Locomotive Boilers presented a report which included a formula for use in designing of such valves, the formula applying only to locomotive boilers using coal as fuel and under conditions now prevailing for the stimulation of the draft by the use of exhaust steam from cylinders of the locomotive and by means of the ordinary steam blower. As a result of tests the following formula is recommended:

$$A = \frac{0.08\ H.S.}{P}$$

A = Outlet of valve in sq. ins.
$H.S.$ = Boiler heating surface in sq. ft.
P = Absolute pressure-gage pressure + 15 lbs.

This formula will provide, on boilers carrying 200 lbs. gage-pressure, an outlet that will take care of 4.1 lbs. of water per sq. ft. of heating surface per hour.

In answer to a question, it was stated that the area A in the formula is the minimum outlet of opening which equals the area of the circle times the lift times a constant depending upon the form of seat and the stiffness of the spring. On account of the uncertainty in the determination of this value the report was not sent to letter ballot but was merely accepted.

FREIGHT TRAIN RESISTANCE.—An individual paper entitled "Freight Train Resistance; Its Relation to Average Car Weight," was read by Prof. Edward C. Schmidt, Assistant Professor of Railway Engineering, University of Illinois. This same paper was presented to the American Society of Mechanical Engineers and printed in its Proceedings for May, 1910, and it will also be published as a bulletin of the Engineering Experiment Station of the University of Illinois. The paper gives a resumé of a number of tests made on service freight trains, observations being taken with a dynamometer car,

to determine the resistance of freight trains under the usual conditions of operation; they were designed to disclose at the same time, if possible, the relation existing at any given speed between train resistance and average car weight. Since the chief use of such information is in the production of locomotive ratings, the conditions of the tests have been made like those which prevail in normal freight train operation. The speed range, for example, is from 5 to 35 miles per hour, and the trains experimented upon were trains in regular service and usual in their make-up. The track upon which the tests were made is believed to be representative of good main-line construction.

The report deals with the results obtained from tests of 32 ordinary freight trains varying in weight from 747 to 2,908 tons and in number of cars per train from 26 to 89. From an analysis of the data obtained a number of curves, tables and equations are presented, giving the relation between resistance and car weight at various speeds and between resistance and speed, for average weight per car. These curves are very valuable for rating locomotives and they prove experimentally that at a given speed the tractive effort required for each ton of weight of the train decreases as the average gross weight of the cars making up that train increases.

VARIOUS COMMITTEE REPORTS.—The Committee on Widening Gage on Curves presented the same recommendation that was presented by a similar committee to the American Railway Engineering and Maintenance of Way Association and in view of the fact that the subject is properly in the field of the latter association the convention promptly adopted it and sent it to letter ballot. The Committee on Steel Tires reported that the cost of investigations necessary to the formulating of specifications for steel tires made it hesitate to continue the work unless specifically so ordered by the Association. The matter was referred to the Executive Committee for action, but the opinion of the convention seemed to be that the subject of steel tires is of sufficient importance to warrant considerable expenditure in the study preparatory to promulgating specifications. The Committee on Locomotive and Shop Operating Costs presented an extensive report which was read by title only and not discussed.

Two committees, those on Lumber Specifications and on Train Brake and Signal Equipment presented the same report as was presented at the convention of the Master Car Builders the week before, and both reports were accepted with no discussion. The Committee on Safety Appliances pursued the same course as the similar committee in the other association, as noted in our issue of June 23. It reported that in view of the new federal safety appliance law and the investigations now being undertaken by the Interstate Commerce Commission preliminary to the issuance of safety appliance orders, it is thought best that the Association refrain from any change in its safety appliance rules and that the individual members should do the utmost to inform the Commission upon the present state of the act regarding safety appliances.

Committees on Revision of Standards and in Motive Power Development presented no reports.

Officers.

The following officers were elected for the ensuing year: President, C. E. Fuller, Superintendent of Motive Power, Union Pacific R. R.; Vice-Presidents, H. T. Bentley, Assistant Superintendent of Motive Power, Chicago & Northwestern Ry., and F. Crawford, General Superintendent of Motive Power, Pennsylvania Lines West; T. Rumney, Mechanical Superintendent, Erie R. R. Treasurer, Angus Sinclair. Mr. Jos. W. Taylor is Secretary, with offices at 390 Old Colony Bldg., Chicago, Ill.

Tests of Oil Fuel at Panama.

Since the first installation of oil burners, under two locomotive-type boilers at the Mt. Hope pumping plant in 1908, the use of California crude oil has been greatly extended until all the dredges and marine equipment on the Pacific end and 12 mogul locomotives on the main line of the Panama R. R. use this fuel exclusively.

The Union Oil Co., of California, in 1906 held a license to maintain a pipe line across the Isthmus and to furnish oil to the Canal Commission and to the Panama Railroad at 90 cts. per bbl. (42 gals.). In 1909 the company was allowed to charge $1.10 per bbl., delivered into tanks, and was guaranteed a minimum consumption of 30,000 bbls. per month. The maximum was placed at 60,000 bbls. and for above this amount the company proposed to charge more than $1.10. As the present monthly consumption is 55,000, it is desired to curtail consumption wherever advisable.

The testing engineers of the Mechanical Division have been making studies of the several oil-burning plants to find what changes may be made to improve the efficiency. The results of these studies are published in the "Canal Record" of June 8.

The minimum efficiency found was 7.12 lbs. water (from and at 212° F.) per pound of oil; the maximum was 14.22 lbs. of water. In most cases oil at $1.10 per bbl. is cheaper than coal at $6.25 (cost of Pocohontas at all points except Cristobal and Colon). The tests, tabulated below, were made as nearly as possible under operating conditions. The wide variation shown is accounted for by knowing that their settings were originally designed for coal, and that little adaptation had been made for oil fuel. All burners are of the steam-spraying type, taking steam at boiler pressure and oil under heads of 30 to 100 ft. The best results have been obtained at Rio Grande, where the air supply is preheated by passing through fire-brick passages. The maintenance of brick-work has been heavier than with coal fuel, but it is expected that new types of furnaces which are now being developed will reduce this without impairing thermal efficiency.

TEST OF BOILERS USING OIL FUEL, ISTHMIAN CANAL ZONE.

Type	Number.	Location.	Rated boiler HP. of test. (Per cent)	Boiler efficiency (Per cent)	Equiv. evap.*
Abendroth and Root (water tube)	6	Cristobal ice plant	118.	69.5	12.56
Locomotive	2	Mount Hope pumping station	65.0	39.0	7.12
Locomotive	3	Gatun pumping station	198.	61.6	11.23
Keeler (water tube)	6	Gatun power plant	95.	71.7	13.07
Scotch marine	2	Gorgona pumping station	170.	75.2	12.80
Horizontal fire-tube	6	Gorgona shop power plant	79.	70.0	12.49
" "	6	Las Cascadas air compressor plant...	98.	74.1	13.28
" "	12	Empire air com. and power plant	103.	76.5	13.69
" "	6	Rio Grande air compressor plant.....	90.	77.6	14.22
Vertical fire-tube	3	Ancon pumping station	173.	68.5	12.50
Manning vertical fire-tube	5	Balboa power plant	71.	63.3	11.75
Stirling (water tube)	2	Balboa power plant	115.	73.8	12.82

*Pounds of water from and at 212° F. per lb. of fuel oil.

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In the planning of engineering construction work or methods for its execution a matter which is not always recognized or given its full weight is the limitation of human power and endurance under conditions of stress, and the result in some cases has been that the completed work falls short of what was expected or desired. In fact, a method of procedure or a type of construction which presents particular advantages in itself, or when planned in the office, may be found unsatisfactory or almost impracticable under working conditions in the field. This is particularly the case where difficult work must be done by unskilled or semi-skilled labor, which (while it may be competent and faithful) has no personal or particular interest in the success of the work.

This matter has been brought forward recently in connection with works where difficulties of this kind have been encountered by the engineers in charge. In one of these cases, some underground concrete work in wet clay was to be made waterproof by an outside course of brick laid in and covered with a hot asphaltic composition. The plan was good enough in itself and had been used somewhat extensively, but in this case the designers apparently overlooked some of the difficulties of carrying it out under the conditions of the work. The man had to work in a very restricted space, and in the heat and fumes from the asphalt which he was required to handle. He was supposed to dip each brick thoroughly in the asphalt, bed it carefully in the asphalt already troweled on the concrete, and then spread a layer of asphalt over the brick course, making this layer perfectly continuous and homogeneous.

The contractor and the engineer in charge found that it was very difficult to ensure thorough and reliable work, unless under the constant supervision of an inspector or foreman. Even then, in the confined space, the semi-darkness and the smoke, it would be difficult to detect spots slighted by the man when in a hurry to finish a particular piece or to get to a more comfortable position and get some fresh air. Very likely the man would have no deliberate intention of slighting his work, but his endurance would occasionally be overtaxed, with the possible result of producing weak spots in his work. It must be borne in mind also that the workman probably had no real comprehension of the vital importance of his work in relation to the future use of the structure.

In another somewhat similar case, special care had been taken to secure a very dense and solid concrete, and the opinion was expressed that if the work proved to be watertight it would be due in all probability to the character of the concrete rather than to the somewhat elaborate waterproofing, the reliability of which (under the circumstances) was considered somewhat doubtful.

In another case, some steel ribs for reinforcing underground concrete work were designed in sections specially with a view to convenience of field connections. While the sections were handled easily enough in the open, they were of such size and weight that it was with great difficulty the few men in the small headings could handle them and get them into place by main strength, the use of tackle being impracticable. The progress of the work was delayed considerably on this account, and eventually the resident engineer succeeded in having the plans changed and the ribs built in smaller sections, with the result that the work progressed more rapidly and without further complaint from the men.

Of course much work of this kind is done, and must be done, under conditions which are trying to the best and most conscientious workmen, and which offer ample opportunity for careless men to slight their work. But more careful consideration of such conditions in the planning of the work, and consultation with those who have had direct charge of such work, may often result in the devising of simpler or different methods which will give results quite as good (or even better) and with greater prospects of ensuring reliable and thorough work.

How many of our great industrial or commercial corporations have a well-selected special library with a competent person in charge to aid in making it instantly available to any member of the corporation staff who wishes all possible light on some knotty problem? There are such libraries, but they are relatively few. In the vast field covered by various public-service corporations, including those owning and operating steam and electric railways, lighting and water plants, etc., we remember only one such library, and that has been created by a firm of designing, constructing and operating engineers which also controls some public utilities. Of course the legal departments of some of the large railways and other similar companies have libraries at their command, but presumably many of these are the private property of counsel. In the engineering departments of these companies such books as are available, we should say at a guess, are at least 99% private property, and very likely the same holds true in other departments. It is rare, indeed, for an industrial or business corporation of any kind to make sure that each and every department has at its command all the technical or other special literature that would aid its members in their daily work. The foregoing remarks have been prompted by the article on the Library of the Public Service Commission of the First District, New York State, printed elsewhere in this issue. The sister Commission for the Second District has at its command the great State library at Albany, with which the author of the article just mentioned was long connected before assuming charge of the Commission library in New York City. The Wisconsin Railroad Commission has at its command the remarkably efficient State Legislative Reference Library at Madison, Wis. We commend the fact that such libraries exist to those who scoff at State regulation of public-service corporations. An unprejudiced study of these and many other features of the work of such commissions will show that they are making well-planned, honest attempts to exercise their functions in the light of the best information available; and that in many respects they are far in advance of the practice of the corporations they are created to supervise—as very properly they should be.

The discussion of railway signaling by Mr. J. B. Latimer, on an earlier page of this issue, addresses itself to the general engineering community rather than to the signal engineer. Signal engineers, being intensely absorbed in the complex details of their art, as a rule are quite fixed in their views; and not unnaturally they are first of all interested in perfection of apparatus, which is apt to be synonymous with complexity of apparatus. But Mr. Latimer's strong plea is *simplicity*, and he opposes the formidable pyramiding of delicate safeguards which is characteristic of all the most advanced signaling devices. Herein he will surely not lack support. When the effort toward absolute safety is driven to such a degree of refinement that through sheer excess of intricacy it constantly threatens paralysis of operation, the time is ripe to consider moderating this effort. And the question is not only: Do the last refinements give corresponding gain of safety, but: Do they really add to the safety at all?

Even apart from this, the tremendous installations costs alone are a reason for scrutinizing the modern signaling equipment. There are so many points of possible improvement in railway property, and the burden of expense is coming to be so heavy, that a time has been reached when excess expenditure in one class of improvement must be discouraged. Simpler blocking, simpler signaling equipment throughout, should have a respectful hearing.

How to make the best of poor materials is a question continually being presented to many engineers. The question applies with particular force to many hundreds of thousands of country roads—but unfortunately for the users of the roads it is not often submitted to engineers.

Earth roads are the best that can be expected for years to come throughout an immense area of the country. Some earthy materials, if only they are protected by good sub-surface and surface drainage, do very well for rural traffic, but an all-clay or an all-sand road presents a difficult problem. A mixture of sand and clay in proper proportions makes a very good earth road, but it does not always happen that the needed complementary material is available in sufficiently close proximity to the sand or clay road to make its use feasible.

Elsewhere in this issue we reprint portions of an interesting and suggestive paper on sand-clay roads in western Kansas. The author claims no novelties, except in the application of known principles to local conditions—which is about all of novelty that falls to the lot of a large percentage of engineers.

What is to be done where roads deep in sand or heavy with clay are found without the needed complementary material at hand? Of the two perhaps the deep sand road is the worse in such a case, since through drainage and proper shaping of the surface will render most clay roads fairly passable through a good part of the year, while there is relatively little that can be done to the sand road, short of bringing material from a distance. Few rural districts could stand the road tax that would be entailed by bringing clay any great distance, even if assured that it could be so incorporated with sand in place as to produce a satisfactory road. For short stretches of very sandy country roads wood shavings or brush are sometimes used, but even where one or the other of these is available it serves only as a short-lived palliative.

How far and how fast the use of road oils and tars may yet be extended from the city and the town through rich farming communities and on into sparsely-settled and relatively unproductive country regions is an interesting subject for speculation. Only the promoters of proprietary materials, machines or methods have the boldness to maintain that the use of oils and tars have passed beyond the experimental stage in

cities and towns—some of which have paid dearly though perhaps unnecessarily for their experience. Most rural sections will be slow to make such experiments: first, because they cannot or think they cannot stand the expense; second, because of an innate caution in breaking away from beaten paths—even though the paths be deep in clayey mud or heavy sand.

Some excitement appears to have been caused in Oakland, Cal., because the People's Water Co. has included depreciation charges in the data submitted by it for the guidance of the city officials in fixing water rates for the year beginning July 1, 1910. We have no detailed knowledge of the local conditions involved, but the general principle of taking depreciation into account both for rate-fixing and for purchase-price valuations is sound. Water and other public-service companies are just beginning to realize this. Heretofore these companies have criticised cities for making inadequate or no provision for bond redemption and for depreciation, while at the same time but few of the companies made any provision whatever for bond redemption and many of them quite ignored depreciation.

Public sentiment and the courts, prompted and guided by some of the ablest engineers and accountants of the country, have recently made it next to impossible for these companies to continue their neglect of depreciation; at least not without being liable to pay the penalty when called to a rigid accounting in a rate-fixing case or a municipal-purchase valuation. So forcibly has the importance of making proper yearly allowances for depreciation been brought home to public-service corporations of late that a number of cases have been reported of engaging engineers to make valuations for the purpose of determining depreciation and setting it up in the accounts. Doubtless similar unreported cases have occurred.

What we have said should not be construed as taking sides in the Oakland controversy, and particularly not as endorsing the reported generosity of the company in charging off five years depreciation at once—but with the evident intention of placing the same amount in the expense account of a single year, and thus materially raising its claims for an advance in rates.

The Engineering Society as a Molder of Legislation.

Although the real causes of the troubles in the body politic often lie deeper than any law can reach, the annual grist of mandatory statutes all aimed to relieve undesirable conditions continues to grow greater year by year. Most of this state and federal legislation is general in its effect and concerns engineers only in their capacity as citizens, but from time to time the statute books record measures that are of vital importance to the engineer in his chosen profession. As a rule these measures come to the attention of the engineer only after they have become law when their enforcement works some hardship and their unreasonable nature causes wrath. This condition of affairs is being gradually impressed upon the profession and we are glad to notice that engineers are coming to recognize the fact that they have a duty outside of the design and construction of machines and structures and that the influencing of legislation which affects them or their work is an obligation which they cannot afford to avoid.

In ordinary legislation which does not involve a party dispute or question of political expediency, in which case all rules of righteous conduct are likely to fail, the legislator comes, or should come, to his conclusions largely as a result of personal study. In legislation affecting any specialty with which the layman is unacquainted the ordinary means of information fail and the concerted action of those competent to judge of the merits of the proposed law is about the only means by which the conscientious lawmaker can come to any decision as to his action. It therefore behooves the engineering profession to supply the necessary concerted action whenever prospective legislation seems to demand it.

It is quite evident that engineers as a body cannot be successfully organized on the spur of the moment to take charge of any movement directed toward a special law. It follows that to established societies of engineers the profession must look for any progressive action in this direction. Within the past few months there have been at least four notable attempts to influence legislation made by engineering societies, and for the benefit of other societies that may feel inclined to follow the example set by these four we have noted below in brief the action they have taken.

In our issue of June 9, 1910, we noted at some length the proceedings of the annual meeting of the Engineers' Society of Pennsylvania, an association which more than any other has directed its attention to the influencing, or, if that is too strong a word, to the suggestion of correct and desirable legislation in matters that affect the engineering profession. Going further than the mere attention to legislative bills already drawn and introduced, this society has appointed committees on such subjects as industrial education, safety appliances, public health and conservation, and it is to be the duty of each of these committees to observe the progress of the special branch to which it has been delegated and to report to the society whatever recommendations it is desirable for the society to make to the state legislature, or possibly the federal congress, either upon entirely new measures or upon those already before those bodies.

On another page of this issue is an account of the annual convention of the American Society of Civil Engineers, at which the special committee on the Licensing of Civil Engineers reported. In appointing this committee the Board of Directors of the society said that

> It is the duty of the American Society of Civil Engineers to use its influence in the proper formulation of all legislation by the general Government, or by any of the states of the Union, which affects the practice of engineers.

Here is an excellent example of this desirable function of a technical society. There is gradually growing all over the United States a movement toward the licensing of engineers. This is a most radical departure from established order and as such should be the subject of most careful consideration by the legislators who would be responsible for any such law, but these legislators have no way of knowing what is best for the engineering profession or what even is desired by it except through scattered individual opinion and the united expression by some influential body, such as the American Society of Civil Engineers. Previous to the appointment of the committee noted here there had been a bill introduced into the Legislature of the State of New York, which was anything but satisfactory to the engineers of the state but which stood an excellent chance of passing until the committee from the society strongly advocated a more lengthy deliberation by the legislative committee having it in charge. This, the committee was perfectly willing to do; it only needed the expert advice that the society was able and willing to give.

The third instance that we would note is that of the American Railway Master Mechanics' Association, whose annual convention we report on another page of this issue. The engineers on the railways of this country have had their many worries in the past with our state and federal legislators. As a result of certain real and fancied wrongs committed against the people by the managements of the railways, wrongs with which the technical branch of the organization had nothing whatsoever to do, the past few years have seen passed a number of laws affecting both the economic and the mechanical operations of railways. As to the rights of those laws affecting the financial administration, the present discussion has no concern, but it is a matter of observation that some of the mechanical requirements forced upon the railwa by recent laws would certainly not have be recorded on the statute books had the make of the laws been conversant with the state the art which they attempted to regula Against this sort of legislation the Master M chanics' Association has taken a stand and h offered to legislative committees the benefit the experience and knowledge of its membe so that each committeeman may, if he choos get the opinion of an expert on the matter und proposed regulation. Furthermore, the Pre dent of the association, in his annual addre recommended that the association forsee leg lation and so regulate its standards that val able information will be available to the legisl tors when they wish to make or revise laws.

Last in this catalogue comes the Americ Society of Mechanical Engineers, whose Pres dent has recently appointed a committee on R lations with the Public. As the title indicate this committee has a somewhat broader fie than the ones noted before, but the general ide in its formation is the same. There are man questions now in the public mind that the en gineer is especially qualified to solve. The questions may or may not eventually reach th stage when they will be recognized by the law, but in either case it is the plain duty of the engineer as a citizen to give to his fellow citizens the benefit of his expert knowledge.

For a society to have any great influence with the bodies of men to whom it addresses itself there are some things it must avoid and others upon which it must insist. Primarily the recommendations of the committee appointed to look after any specific legislation must be endorsed by the society as a whole. Divided opinions are of no weight and unanimity carries greater force to an outsider than any other one thing. To reach this unanimity there must be much giving and taking among the various members, but a compromise must be reached before any public action is taken. Secondly, the society ought to have a high class of membership to lend to its recommendations the authority that is necessary. This brings up the question of membership qualifications and method of election, a subject that always arouses debate in our national societies and one that cannot be discussed here, but reference might be made to the fact that the great technical societies of England and the continent require rigid entrance examinations from their members. The ineffectiveness of the college and the civil service examination in discovering genius is almost sufficient argument against this method, but it betokens a careful guarding of the membership lists that many societies on this side the ocean might follow.

One other thing may tend to reduce the influence of any society appearing before legislative committees, and that is the financial interest of its members in the proposed statute. In case the society is made up of men who are so involved, it becomes a special pleader instead of a disinterested adviser. Thus, for instance, the American Railway Master Mechanics' Association is undoubtedly honest in its statement, through its individual members though not by the convention assembled, that the self-dumping ash-pan on a locomotive is a device which has not been brought to perfection and its enforced use on railways is an arbitrary exercise of federal power, but the fact that the experimenting upon and the equipping of locomotives with such ash-pans is costing the railways many hundreds of thousands of dollars doubtless causes many legislators to discount the statements of the mechanical engineers employed by those railways.

The term "lobbyist" has come into disrepute because it connotes the unpleasant activities of one who regards the benefits desired by his client above the public good, but it is perfectly conceivable that there be a desirable lobbyist, that is one who does not promote the passage of a law through sheer force of persuasion, of whatever nature that persuasion may be, but who presents to those responsible for the enforcing of

the law valid arguments for or against based on expert knowledge and long experience. It is in the latter class that the engineering society should be placed and its power for good there is extensive. The example set by the one state and three national societies noted above is a worthy one to be followed by the smaller state and local associations in their respective fields.

LETTERS TO THE EDITOR.

"Hay Steel" in the Plattsmouth Bridge.

Sir: In your article on "Hay" steel published in Engineering News of June 2, there is made reference to Plattsmouth bridge, over the Missouri River at Plattsmouth, owned by the C., B. & Q. R. R. Co.

The author of this article states that the bridge was built of Hay steel. In the report of Mr. Geo. S. Morison, Chief Engineer of the bridge, he states as follows:

The greater part of the steel used was made in a furnace at Glenwood (a suburb of Pittsburg, on the north bank of the Monongahela River) which furnace was rented by Messrs. Hussey, Howe & Co., expressly for this work; about 160 tons, however, were made by Messrs. Schoenberger & Co. in the open-hearth furnace at their works adjoining those of Messrs. Hussey, Howe & Co. at 14th St., in Pittsburg. The capacity of the Glenwood furnace was five tons per melt, that of the Schoenberger furnace seven tons. The manufacture was conducted in the usual manner excepting that at the time of throwing in the spiegel there were also thrown in about 100 lbs. of "Hay mat," which melting, flowed over the surface of slag and did not appear to have any effect on the material.

There is also appended to this report an analysis of the Hay mat under discussion, which analysis your author states has not come to his knowledge. It occurred to me that this analysis also might be of interest and it is herewith quoted:

This mat was manufactured by Mr. A. T. Hay, at Burlington, Iowa; a chemical analysis showed its constitution to be as follows:

Silica	22.21%
Alumina	5.76%
Protoxide of iron	56.20%
Peroxide of iron	12.74%
Lime	2.08%
Magnesia	0.48%
Potassia	0.08%
Manganese	a trace
Phosphoric acid	0.154%
Sulphur	0.043%
	99.747%

The indications were that this had no effect either injurious or beneficial.

In view of Mr. Morison's statement as to the amount of "Hay" steel used in the Plattsmouth bridge, and his remarks as to the value of the mat, it is evident that the statement in the article referred to regarding its use at Plattsmouth is not accurate.

The writer recalls having heard Mr. Morison state his disbelief in the claims of Mr. Hay, and his opinion that the use of the mat was of no great consequence either one way or the other.

C. H. Cartlidge,
Bridge Engineer, C., B. & Q. R. R. Co.

209 Adams St., Chicago, Ill., June 6, 1910.

The Use of Bitumen as Fuel.

Sir: Referring to the inquiry of Sir William Wilcocks in your issue of May 12, regarding the use of bitumen as a fuel for condensing water for domestic purposes and as fuel for dredgers: It might be interesting to note that there is an oil town, called McKittrick, near the southwestern extremity of the San Joaquin Valley, Cal., having a population of about 500 people, where bitumen has until recently been used almost exclusively as a source of fuel for domestic purposes. This particular portion of the valley is an arid country containing no other vegetation than sage brush. In the adjoining foothills are extensive deposits of bitumen. This bitumen, termed locally "native coal," is mined and delivered to the residents in the same manner as coal in the city.

When mixed with the stalky parts or the dried roots of the sage brush it burns with a yellowish flame, producing quantities of soot and ashes, but a very satisfactory heat. Except for the necessity of repeatedly emptying the ash pan and cleaning the soot from the chimney is as quite as satisfactory as coal. I have seen it successfully used in the cook houses of pipe-laying and ditching camps numbering 150 men.

The function of the sage brush roots seems not to be so much to keep the mass burning as to collect the more liquid portions of the bitumen and prevent dripping into the ash pan before combustion is complete. The roots are more or less protected from the blaze so that a small amount goes a long way.

I have never seen this method applied on a scale large enough for generating steam, but have no doubt that it could be used successfully.

Very truly,

C. P. BOWIE,
Asso. M. Am. Soc. C. E.

Assistant Engineer, Associated Pipe Line Co., 1360 Spring St., Berkeley, Cal.

Formulas for Determining Street Crowns When the Two Curbs Are at Different Elevations.

Sir: In Engineering News of May 5, 1910, we note a paper by G. B. Zahniser, entitled "Suggestions for Rational Formula for Street Pavement Crowns."

In view of recent articles on this subject by Mr. George C. Warren, entitled "Paving Practice with Respect to Crowns for Roadway Pavements" (Eng. News, Dec. 19, 1909), and a paper by Mr. P. E. Green (Proc. Am. Soc. C. E., Vol. xxxv., No. 6, August, 1909), discussion of this matter is timely. As a further contribution we enclose the following formula, which we use in our practice and which was first suggested by our Mr. C. L. B. Anderson in the solution of the problem for locating the position of the crown in the street when the two curbs are at different elevations.

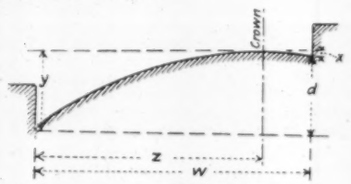

Fig. 1.

In Fig. 1 let difference of elevation of gutters be d.
Let regular crown be C.
Let width of roadbed be W.
Let distance from lower gutter to crown be Z.
Let difference of elevation of crown and lower gutter be y.
Let difference of elevation of crown and upper gutter be x.
Then from property of parabola

$$y = C\frac{(Z)^2}{\left(\frac{W}{2}\right)^2} \text{ and } x = C\frac{(W-Z)^2}{\left(\frac{W}{2}\right)^2}$$

but $y - x = d$.

Substituting $d = C\frac{(Z)^2}{\left(\frac{W}{2}\right)^2} - C\frac{(W-Z)^2}{\left(\frac{W}{2}\right)^2}$.

$$\frac{d\,W^2}{C\,4} = [Z^2 - (W-Z)^2]$$
$$= [Z^2 - (W^2 - 2\,W\,Z + Z^2)]$$
$$= [Z^2 - W^2 + 2\,W\,Z - Z^2]$$
$$\frac{d\,W^2}{4\,C} + W^2 = 2\,W\,Z$$
$$\frac{d+4\,C}{4\,C}\,W^2 = 2\,W\,Z$$
$$\frac{d+4\,C}{8\,C}\,W = Z.$$

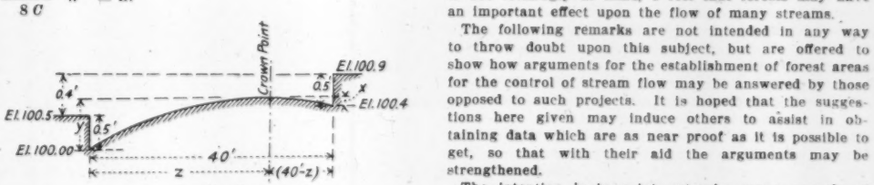

Fig. 2.

In Fig. 2 let difference between elevation of gutters be 0.4 ft.., as shown.
Let regular crown be 6 ins. = 0.5 ft.
Let other dimensions be as shown:

$$y = 0.5\frac{(Z)^2}{(20)^2}, \text{ and } x = 0.5\frac{(40-Z)^2}{(20)^2}$$
$$y - x = 0.4 \text{ ft.}$$
$$0.4 \text{ ft.} = \frac{0.5}{400}[Z^2 - (40-Z)^2]$$
$$160 = 0.5\,[Z^2 - (1{,}600 - 80\,Z + Z^2)]$$
$$320 = [Z^2 - 1{,}600 + 80\,Z - Z^2]$$
$$1{,}920 = 80\,Z$$
$$Z = 24.0 \text{ ft.}$$

Taking formula associated with Fig. 1.

$$Z = \frac{d+4\,C}{8\,C}\,W$$

Substituting

$$Z = \frac{0.4 + 2.0}{4.0}\,40$$
$$Z = \frac{2.4}{4}\,40 = 24.0 \text{ ft.}$$

To find elevation of crown:

$$y = 0.5\frac{(24)^2}{(20)^2}$$
$$= 0.5\,\frac{576}{400}$$
$$= 0.72 \text{ ft.}$$

Elevation lower gutter =	100.00
	72
Elevation crown	100.72

In the discussion of this subject by Mr. Warren we note that he differentiates for crowns of streets paved with the different materials and for pavements laid to different grades; also where car tracks occupy parts of the street. Besides abnormal or exceptional cases it appears to us that this is unnecessary refinement.

As a general proposition in our practice we make the width of the roadway or cartway $W = 3/5$ the entire width of street, leaving 1/5 each for sidewalks. Where street or other railways occupy the street a proper allowance should be made. In the very wide streets where parkways are necessary it is our usual practice to make the paved portions of this parkway one-half the entire width. For the level cross-section we generally adopt for the crown of the street 2% of the entire width of roadway, or roughly, allow 1 in. to each 5 ft. of width between curbs. At any point the crown varies with the square of the distance.

Wherever possible curb exposures are uniform, but in extremely flat contours, and where the crown is practically level, the minimum and maximum curb exposures are adopted as 3 ins. at summits and 9 ins. at inlets, and the gutter line is broken as frequently as needed to allow for drainage, not less than 1/24-in. per ft. of distance along the curb. It is our practice to place inlets 25 ft. back of the property lines, locating two inlets to each such intersection.

It is of course understood that exceptional conditions may modify these conclusions, but our general practice conforms in the main to the statements given.

Respectfully,
Hazlehurst & Anderson,
By James Nisbet Hazlehurst.

Candler Building, Atlanta, Ga., May 9, 1910.

What Stream Gagings Indicate as to the Run-Off from Forested and Barren Areas.

Sir: In view of the recent extended discussion of the relations between deforestation and stream flow, and your editorial remarks from time to time as to the general lack of proper data on the subject, some of your readers may be interested in the following amplification of notes by me in an informal address before the Pennsylvania Forestry Association a year or so ago.

It will be noticed that the title I have chosen is not "What Stream Gagings *Prove* as to the Effect of Forests on Run-off." Such a discussion would be welcomed by all who have studied the problem of stream run-off, but so far as my knowledge of stream-flow records goes, it must be admitted that they apparently do not *prove* that forests materially influence stream flow, although many indicate it strongly, but if records are selected, they may be made to indicate almost anything in relation to this subject. Nevertheless, though absolute proof is not seemingly at hand, I feel that forests may have an important effect upon the flow of many streams.

The following remarks are not intended in any way to throw doubt upon this subject, but are offered to show how arguments for the establishment of forest areas for the control of stream flow may be answered by those opposed to such projects. It is hoped that the suggestions here given may induce others to assist in obtaining data which are as near proof as it is possible to get, so that with their aid the arguments may be strengthened.

The intention is to point out why many records of stream flow, offered as evidence on this point, do not appear to be the absolute proof we need; for the large expenditures proposed by state and Federal Governments should be based on conclusions derived from accurate information. The Water Supply Commission of Pennsylvania, among other organizations in the United States, is seeking this knowledge, as will be outlined below.

The generally-accepted theory is that forests make stream flow more uniform, reducing floods and increasing the flow in dry seasons. Another is that forests increase the actual water yield from a given drainage area, but some authorities believe the opposite, that the presence of forests does not equalize the flow and reduces the actual yearly water yield. This paper deals only with the first proposition.

From all parts of the country comes the cry, "Increase the forests to preserve the water-supply," a conclusion based on strong circumstantial evidence, and upon it recommendations involving the expenditure of large sums are based. Is this evidence sound enough to warrant such dependence? Below are given data on both sides, from which each may draw conclusions.

It should be borne in mind that conditions other than the presence or absence of forests affect the character of the run-off of streams; and it should be remembered that some of these influences may work on either side and attain considerable importance.

Before offering this evidence and explaining its somewhat circumstantial nature, permit me to enumerate a few of the other features which may influence rates of run-off.

(1) Steep, rocky slopes, bordering narrow valleys, with steep declivity in the streams, usually admit of more rapid passing out of the water, allowing but little

to soak into the soil. The presence of lakes, ponds and marshes affords storage and permits delay in the passage of floods, and tends toward a reduction in their violence.

(2) The surface cover, whether of rock or clay, and thus impervious or nearly so for the absorption of water; or sandy or gravelly, allowing the rain or flowing water to soak in, has its effect upon the seasonal distribution of the run-off. In limestone regions, where the water penetrates into underground pools, to come forth in springs, the dry-weather stream flow is usually large.

(3) The catchment area may be long and narrow, receiving successive tributaries, or fan-shaped, with radiating tributaries of approximately equal size. A fan-shaped drainage area might be so traversed by tributaries that all or nearly all meet near one point, in which case the water from the whole area would pass into the main stream at this point at nearly the same time, and cause a very high rate of flow below. When the tributaries discharge successively, however, the maximum from one follows that from the next below, carrying off perhaps the same total amount of water as under the other conditions, but doing so in a longer time and thus the main stream does not reach such a high rate of flow.

(4) The larger the drainage area of the stream, the smaller, other conditions being equal, is the rate of flood run-off per unit of area, usually due to a more or less modification of the conditions of successive discharge of tributaries as described above.

To return to the evidence above referred to. This is of two kinds, first, observations made by those familiar with certain streams for long periods, and second, records of stream discharge.

If one inquires of a farmer as to the change in the flow of the stream passing through his farm during his remembrance, he will often say that its flow is more erratic than it used to be. Owners of mills operated by water power through the state generally made affirmative replies to questions of this sort sent to them by the Pennsylvania Water Supply Commission, and most of them added "it is because the forests have been cut off." Are they not only expressing an opinion obtained from someone else? These men watch their streams carefully, for the streams are their source of income and the mill owners think they know about them, but one is apt to think things are not as they used to be; memory alone cannot establish such a fact. During a recent drought old residents and observers familiar with streams stated that this or that stream was lower than ever before and pointed to marks and rocks never before seen above water, but the records showed that in many instances the streams had previously been lower; in some cases within a few years.

In traveling about the state the writer comes in contact with men interested in companies for the supply of water, who generally regard forests as one of their best friends. Many companies are preserving tracts of timber on the drainage areas of the streams used as sources of supply. Others use streams heading in and passing through the State Forest Reservations, and in enumerating the good features of their water-supply systems this fact is brought prominently to notice. One company which has a large tract of timber on its drainage area in the anthracite coal field is carrying on systematic forestry; the old trees are cut and sawed into lumber, brush is burned under supervision and the young trees given a chance to grow and are protected from fire. A large lumber company in the northwestern part of the state is contemplating a water-supply system for its mill and employees; the stream to be used is well timbered, but they have arranged that this timber is to be the last sawed at the mill. The opinions of these practical men are often based on observations of their own streams, and they are sure enough of their reliability to spend money on such work.

This is all in a way circumstantial evidence. It is not proof on either side, and does not actually prove that deforested areas cause more fluctuations in stream flow, but it is largely this sort of evidence upon which we have founded our conclusions, and upon which we are recommending state and national forest reservations for water conservation. Of course it is recognized that forest reservations are not set aside merely for the conservation of water.

The other kind of evidence, more exact and by many considered proof, is the evidence of stream-flow records. These are of two kinds: (1) those in which the flow of two streams, subject to approximately the same rainfall, but having different conditions of forest cover, are compared, and (2) those in which the flow of one stream has been measured for many years, during which deforestation has been in progress.

Under the first class consider some results on New Jersey streams. Discharge measurements on the Passaic River in northern New Jersey during the dry year 1881 are compared with the measured flow of some other streams whose drainage areas are comparatively barren, while the Passaic at that time drained a region that was quite well forested. These results may be expressed in percentages of the total yield, as follows: In the three spring months of 1881, a very dry year, the Passaic River yielded 53% of its total flow for the nine months from March to November inclusive, while the barren drainage area yielded 69%. This is the high-water season of most streams and is the season during which ground storage should be taking place. In the next three months the Passaic yielded 25% and the barren streams 20%. During this period the stored water on the Passaic begins to be in evidence. In the last three months the Passaic yielded 22% and the other only 11%, showing how small the ground storage had been on the latter. Examination, however, discloses several points which seem to prevent this from being proof that the forests on the Passaic stored the excess water which was yielded during the last three months. In the first place, geologic and topographic conditions may differ on the drainage areas as well as forest conditions; how far were they responsible and how far the forests? Again, the Passaic was one stream, while the barren areas were drained by a number of small ones; how much did this enter into the results? Small streams, if other conditions are the same, usually show lower dry-weather discharge per unit of drainage area than large ones, for the reason above stated. Again, the distribution of rainfall may not have been uniform over all of the areas considered. Furthermore, on the Passaic drainage area are considerable areas of swamp land; do such areas exist on the other streams and to the same extent?

Mr. Rafter cites data in his paper on "The Application of Principles of Forestry and Water Storage to the Mill Streams of New York, 1899," relative to the variation between maximum and minimum flow in forested and deforested streams. He compares actual gagings on the Hudson at Mechanicsville, N. Y., (drainage area 4,500 sq. mi., with measurements of the Genesee River and Oatka Creek (drainage area, 1,070 sq. mi.) The former had at that time, he says, in the portion of its drainage area above Glens Falls, 2,800 sq. mi., 90% forest, while the latter was very thoroughly cut over. The maximum observed flow of the Hudson, 1887 to 1898, was at the rate of 13.2 sec.-ft. per sq. mi., and the minimum 0.29 sec.-ft. On the Genesee, however, the maximum flow, 1890 to 1896, was about 40 sec.-ft. per sq. mi. and minimum flow 0.08; or in other words, the maximum flow of the Genesee was over three times as great as that of the Hudson, and its minimum flow was just a little over one-fourth as great. May there not be vitiating and doubtful points in this statement as an argument that this difference is caused by the difference in the amount of forests? Are there no other great differences in these drainage areas? Does not flood flow almost always increase as the size of drainage area decreases? Were the maximums caused by equivalent storms; were the minimums during equivalent droughts?

Another example under this class is the flow of two small streams in Delaware Co., Pa., measured by Henry Birkinbine. These two streams drained adjacent areas and weirs were placed on each at a point above which the drainage area was 1 sq. mi. One stream flowed through woodland and the other through open country. These measurements showed that following rains the open stream flowed almost invariably more water than the forested one and during droughts that the reverse was the case. This may have been due to the difference in the amount of forest cover; it looks so, presumably was so, but we cannot say definitely that it was so. Topographical and geological conditions indicated that the two areas were very similar, and that what differences did exist were in favor of a more uniform flow from the barren stream. These data, on account of the similarity of the two streams in all other respects, are nearer proof than the two other instances cited.

Other similar statistics might be repeated, but this is enough to show the character of the data used. To show how the above facts might be misinterpreted, consider some results of stream-flow measurements which illustrate how the flow in streams differs where forest conditions do not seem to play the deciding part.

The Youghiogheny and Casselman rivers meet at Confluence, Somerset Co., Pa., draining adjacent areas in Pennsylvania and Maryland of 392 and 482 sq. mi. respectively. These streams are measured regularly by the Water Supply Commission of Pennsylvania at Confluence, Pa. During the drought of the summer of 1904 these streams were very low; rainfall and forest conditions were similar on the two basins. During this drought the lowest flow of the Youghiogheny was at the rate of 0.068 sec.-ft. per sq. mi. of drainage area and of the Casselman 0.029 sec.-ft. Influences came into play, in the shape of the basin, the geology and topography, causing this difference in dry-weather flow.

To further indicate that if forests do have great influence on stream flow, other conditions may have so much effect as to prevent the records from showing the influence of the forests, the records of the flow of the north and west branches of the Susquehanna River are instructive. The former has been measured since 1899 at Danville near its mouth (drainage area, 11,255 sq. mi.) and the latter at Williamsport (drainage area, 5,680 sq. mi.) since 1895. During these periods several great floods have visited the state. The greatest rate of flood run-off of the north branch at Danville was that of March, 1902, and reached the rate of 27.5 sec.-ft. per sq. mi., while the west branch at Williamsport reached at the same time 29.0 sec.-ft. per sq. mi. The minimum flow recorded for the north branch at Danville was in September, 1900, 0.074 sec.-ft. per sq. mi., and at Williamsport in 1895, 0.072 sec.-ft. per sq. mi. Thus it is seen that the west branch, which is recognized as including much of the best forested area of the state and far better forested than the north branch, has reached, during the 13 years of the record, a higher rate of run-off than the north branch. Its minimum flow was lower, which may be accounted for by the fact of its drainage area being only half that of the north branch, indicating perhaps that the difference in the size of the basins has more effect than the difference in forest cover.

Such examples could be continued, but these are sufficient to show that stream flows vary widely, through other causes than forest cover, and that a comparison of gagings of two streams to show the effect of forests thereon is not an infallible method of proving our point, but that all conditions on the drainage area must be considered simultaneously.

As to the second class of evidence the long-term stream flow records from drainage areas on which forest conditions have changed during the term of record: First, consider Perkiomen Creek, a large tributary of the lower Schuylkill River, draining 360 sq. mi. The flow of this stream has been measured regularly since 1883. The records show that during the ten years, 1885 to 1894, the average minimum flow was 20.8 sec.-ft., while in the eleven years, 1895 to 1905, it was 17.4 sec.-ft., showing that during the latter eleven years the minimum flow was 16.3% less than in the first ten years. The average maximum during the first ten years was 4,908 sec.-ft. against an average maximum during the eleven years following of 5,330 sec.-ft., or 9% greater. This may or may not be due to decreased forest cover during the latter eleven years, but can the flow, which appears less uniform, not be fairly charged to this cause alone. Changes have occurred other than the amount of forest cover on the drainage area; the distribution of the rainfall through the year may not have been as favorable for ground storage and more favorable for evaporation during the last eleven years than during the first ten years. Population and industry have increased on this drainage area during this period, and the deflection of water and its use thereby have likewise become augmented. Two towns, together having a population of about 2,500, have used water from this creek or its tributaries since 1895, while manufacturing plants along its borders are taking more water from it for boiler purposes than formerly.

The records of the Genesee River may be taken as another instance of this class of evidence. Gagings made of the flow of the river in July and August of 1846, when 65 to 70% of the drainage area was in virgin forest, show an average flow in this very dry year of 412 cu. ft. per sec. In 1895, gagings at Rochester showed that the low-water flow of this dry year was 250 sec.-ft., which is 162 sec.-ft. less than of 1846. "So far as can be determined, this quantity represents the approximate reduction in the minimum flow of this stream due to deforestation." If everything else had remained the same from 1846 to 1895, except the quantity of standing timber, if the rainfall in these two periods and the accumulated ground water were identical, if no reservoirs had been built to increase evaporation losses, no canals to cause like losses and seepage, no municipalities or industries had come to deflect the water (such users seldom put back as much as they take out), if the seasonal distribution of the precipitation were the same during and preceding the two periods, and if the early gagings were accurately made; if all this were true, we would have strong reason to lay this difference to forests. Under the conditions as they do exist can we do so?

This is the sort of information we have from stream-gaging records, and it is easy to see how the doubter may pick flaws in it. The Water Supply Commission of Pennsylvania is trying to get something better. It is establishing gaging and rainfall stations on several streams in the northwestern part of the state upon the drainage areas of which lumbering operations are to be begun within a few years, and hopes to get accurate records for a few years while the area is forested, taking rainfall records simultaneously, and carry them on through the lumbering operations and after the trees have been removed. It is the beginning of long-term records and it will be several years before there is anything to show for it, but it seems worth while. We are going to try to remove so far as possible factors which may enter to vitiate the conclusions. Rainfall and temperature records will be maintained at or near the gaging stations and other conditions will be carefully observed.

Farley Gannett,
Engineer to the Water Supply Commission of Pennsylvania.
Harrisburg, Pa., June, 1910.

Notes and Queries.

A correspondent signing himself "G." inquires, "What is the foot of a lake?" He states:

In Engineering News of June 16, pp. 699 and 700, the south end of Lake Michigan is twice referred to as

"the foot of the lake," by experts in engineering and sanitation. This is such a common error, both among school children and those more mature, that it seems worth while calling attention to it.

Mr. H. F. Wilson, Jr., M. Am. Soc. C. E., Empire Bldg., Birmingham, Ala., desires to receive information on refrigerating apparatus, using air as the working fluid instead of ammonia.

Since publishing the editorial article on "The Rapid Spread of the Commission Plan of City Government" in our issue of May 26, 1910, we have learned that San Antonio, Tex., has not yet adopted that scheme of government. As we stated in our article, the list was subject to correction, having been complied from a variety of sources. Mr. Fred Fries, City Clerk of San Antonio, writes us that an effort was made to interest the citizens of San Antonio in the commission plan, but met with little encouragement. The question has been raised as to whether or not Beaumont has adopted the commission plan, but we have not yet secured information which enables us to answer the question. With the exception of these two cities, the list as published in our issue of May 26 has not been questioned.

Statistics of Locomotive Boiler Explosions on American Railways.*

Your committee has thoroughly investigated the subject of boiler explosions and failures and casualties to employees and others resulting therefrom.

Blanks were forwarded to all of the principal railroads of the United States, asking for information in regard to boiler inspection rules and regulations and also as to casualties resulting from boiler explosions of all natures, and attention is called to the following information received in reports from 157 railroads replying to the question as to the number of boiler explosions and failures and casualties to employees and others resulting therefrom during the period from Jan. 1, 1905, to Nov. 1, 1909. These 157 railroads own and operate 43,787 locomotives and 157,160 miles of roadway, and during the period from Jan. 1, 1905, to Nov. 1, 1909, they made 6,012,057,467 locomotive miles. We estimate that there are about 58,000 locomotives in service in the United States; therefore, the reports which we have received cover about 75% of the total number of locomotives in operation in the United States.

Explosions and failures of locomotive boilers are divided into five classes, as follows: Explosions of boiler shells, explosions of fire boxes, damage by burning, rupture of flues, boiler-fitting failures.

Explosions of boiler shells and fire boxes, or damage by burning, etc., are usually due to low water. Of the failures reported, 98.3% were due to low water and 1.7% to other causes.

Of the failures due to low water, 98.6% were due to the failure of the men handling or in immediate charge of the locomotive to maintain a proper supply of water in the boiler; the remaining 1.4% were due to other causes.

Automatic devices, either to maintain the water supply or to act as an alarm when proper supply is not provided, have been proposed and given consideration, but it has been determined that such devices are unreliable and have had the effect of taking away from the men in charge their accepted responsibility.

A statement of the explosions, failures and casualties is shown below:

	Explosions.		Killed.		Injured.	
	No.	Yearly average.	No.	Yearly average.	No.	Yearly average.
Low water:						
Explosion of boiler shells	14	2.9	20	4.1	16	3.3
Explosion of fireboxes.	246	50.9	127	26.3	144	29.8
Damaged by burning..	2,499	517.0	15	3.1	57	11.8
Ruptured flues	66	13.6	0	0.0	3	0.6
Fitting failures	25	5.2	0	0.0	4	0.8
Other causes:						
Explosion of boiler shells	6	1.3	10	2.0	7	1.4
Explosion of fireboxes.	2	0.4	1	0.2	1	0.2
Damaged by burning..	40	8.3	1	0.2	1	0.2
Total	2,898	590.5	174	35.9	233	48.1

In the above table, of the 407 killed and injured, 386, or 94.8% were due to accidents caused by low water, while the remaining 21, or 5.2%, were from other causes, some of these being the result of or incident to wrecks, and a small number are thought to be due to accidents caused by defects in design, material, workmanship or the physical condition of the boilers or fittings, but it is doubtful if any of them could have been prevented by any method of inspection in addition to that which is now in force.

In addition to the failures as shown above, there were also other failures, as follows:

	No.	No. killed.	No. injured.
Rupture of flues	3,204	8	21
Boiler fitting failures	1,609	2	51
Total	4,813	10	72

In analyzing the accidents due to the latter causes, attention is invited to the item of ruptured flues, shown to be 3,204. This, however, covers the record of an average number of 42,200 locomotives per annum for a period of four years and ten months. Assuming 250 flues to each locomotive boiler, the result shows one flue failure per year to each 15,912 flues in service, or, stated in other terms, the percentage of flue failures to the number of flues in service is 0.00006%.

Both of the above comparisons constitute an excellent endorsement of the present high standard of physical condition of American locomotive boilers, and show how small an opportunity there is to improve the present practice of railroads.

Of the 1,634 cases of boiler fitting failures reported, 1,609 are somewhat indefinite and apparently include failures occurring from causes other than the primary failure of the fittings, such as wrecks or other external accidents, many of them doubtless being of a minor character.

At the time the different railroad companies were asked for information as to boiler explosions, casualties, etc., they were also asked to supply copies of their rules and regulations for the care and inspection of locomotive boilers. A review of such rules and regulations as were submitted shows that a very thorough and vigorous inspection of locomotive boilers is being maintained and recorded, and the rules prescribe very thorough instructions as to the proper care of the locomotive boilers.

These rules and regulations plainly show that different localities require different rules and regulations for the care and inspection of locomotive boilers.

In some localities the water that is obtainable for use in these boilers is very detrimental to the boiler; therefore, very frequent inspections must be made, while in other localities the water conditions are very favorable and the period between inspections may be longer. In a general way, the rules and regulations for the care and inspection of the boilers must be made to meet the conditions under which the boilers are being operated, and no general rules will apply in a practical way.

From U. S. Senate Document No. 682, the following information was obtained: The average number of employees killed and injured per annum on account of boiler explosions on locomotives, for the period from Aug. 1, 1903, to Nov, 1, 1908, was 49.7 employees and others killed and 134.2 injured. This Senate document covered a period of five years and three months and includes all the locomotives in use during that time.

During the period from Jan. 1, 1905, to Nov. 1, 1909 (four years and ten months), the replies from 157 railroads having 43,787 locomotives, with a mileage of 6,012,057,467 miles, show that for said period the average number of employees killed and injured per annum was 38.0 killed and 63.1 injured. As the roads replying only represent about 75% of the locomotives in the country, it will be assumed that the figures represent about 75% of the casualties, which would make these figures approximate those furnished by the Government as to the number of persons killed and injured, namely:

Average number killed, reported by Government.. 49.7
Average number killed, reported by railroads (estimated)..... 50.6
Average number injured, reported by Government. 134.2
Average number injured, reported by railroads (estimated) 84.1

*Report of Committee on Design, Construction and Inspection of Locomotive Boilers, presented at Annual Convention of the American Railway Master Mechanics' Association, at Atlantic City, N. J., June 21-23, 1910.

A Report on the Licensing of Civil Engineers.*

At a meeting of the Society, April 6, 1910, the following resolution adopted by the Board of Direction was presented:

It is the sense of the Board that it is the duty of the American Society of Civil Engineers to use its influence in the proper formulation of all legislation by the general Government, or by any of the states of the Union, which affects the practice of engineers; and the Board recommends the appointment by the society of a committee whose duty it shall be to formulate the general lines on which such legislation should be based, and that said committee be requested to report at the next annual convention.

Your committee issued a circular to the membership asking for information concerning laws which are in force, or have been proposed, in the various states and in other countries. As to the advisability of the enactment of laws relating to the practice of engineering, 32 of the 70 members who replied expressed themselves as decidedly in favor of such laws if properly drawn, and only six expressed opposition.

As far as the committee has been able to ascertain, there are statutes of some kind in force, relating to the practice of engineering, in Canada, Mexico, and in the states of Wyoming, Louisiana and Florida. There are also statutes governing the practice of land surveyors in the states of Idaho and South Dakota.

CANADA.—The licensing of engineers is in the hands of each province. In the province of Quebec the law requires that a practitioner of engineering shall be a corporate member of the Canadian Society of Civil Engineers.

MEXICO.—Engineers may practice without a license, except in the city of Mexico, where a diploma from the National Engineering School is required.

WYOMING.—The law covers the practice of irrigation engineering. There is a board of examiners, consisting of the State Engineer and two engineers "of thorough training and experience, appointed by the Governor," and serving without compensation. Fees collected go to defray the expenses of the board. Certificates are issued to five classes of engineers, as follows: (1) Land surveyor; (2) topographic engineer (examination in plain and topographical surveying); (3) hydraulic and hydrographic engineer (examination in surveying and hydraulics); (4) construction and designing engineer (examination in surveying, design of irrigation works and structures, and computation of earthwork); (5) administering irrigation engineer (examination in surveying, hydraulics, construction work, irrigation law and practice). This law is said to be an unqualified success, in that it has placed irrigation work on a higher plane, protecting (to a certain extent) those who are capable of good work, and in a great measure protecting the public.

LOUISIANA.—The law enacted in 1908 makes it a misdemeanor (punishable by fine or imprisonment, or both) to practice civil engineering without a license. Engineers practicing at that time, were allowed to continue to practice by registering, before a certain date, at the court-houses of their respective parishes. After that date, all those not registered were required to demonstrate their fitness before a State Board of Examiners.

The following is condensed from the reply of a correspondent of the committee: A majority did register, but many did not. Some passed the examination, some failed to pass, and some looked at the examination and did not try it. In this way some incompetent persons were got rid of by this law. Doubtless there are some who practice without a license, but no one has been reported to the grand jury for so doing. One member of the examining board has stated that he would rather not antagonize these people until the public began to see the good effects of the law. While the law is intended to cover engineers working for corporations, as well as those in private practice, corporation lawyers contend that it does not so apply, but this question has never been decided. The examinations cover both the practical and theoretical knowledge of the applicant, but are not made difficult.

The following is a brief statement of the requirements of the law: (1) A diploma from an engineering college or school of good standing (said standing to be determined by the Board), or the passing of a satisfactory examination before the Board, upon the following: (A) for surveying: geometry, trigonometry, land surveying, and practical use of instruments; (B) for civil engineering: same as surveying, and in addition thereto, natural philosophy or physics. (2) The practitioner must be 21 years old, of good moral character, and possess "at least a fair preliminary education."

Five members of the Board of Examiners are appointed by the Governor, from a list presented by the Louisiana Engineering Society. Members of the Board are paid $10 per day and expenses. The fees are $1 for the issue of a certificate, and $10 for each examination. The law expressly states that its provisions "shall not apply to the Engineering Department of the United States, nor to the civil engineers and surveyors of other states and territories when in actual consultation with registered civil engineers or surveyors of this state."

FLORIDA.—In this state there is only one restriction, namely, that anyone calling himself a civil engineer, and practicing as such, shall pay the state an annual privilege tax of $10.

In Idaho and South Dakota the law concerns only land surveyors, who must pass an examination before a Board of Examining Surveyors, file a bond of $500, and pay fees of $5 and $15, respectively.

The subject has been agitated in the following five states, in all of which legislative bills have been unsuccessfully introduced: New York, Ohio, Pennsylvania, South Carolina and Washington.

There is an unmistakable tendency toward legislation regulating the practice of civil engineers, and it is important that there should be uniformity in all states, at least so far as the requirements for admission to practice are concerned. The statutes enacted on this subject should define the term "civil engineer" alike, and the following is properly descriptive:

A civil engineer, within the meaning of this act, is one who practices any branch of the profession of engineering other than military. Said profession embraces the design and construction of public or private utilities, such as railways, bridges, highways, roads, canals, harbors, river improvements, light-houses, irrigation works, water supplies, sanitary systems, and the de-

*Abstract of a committee report presented at the annual convention of the American Society of Civil Engineers, at Chicago, June 21. The committee was composed of J. A. Bensel, Wm. H. Burr, James Owen and Chas. W. Hunt.

velopment, transmission, and application of power, and includes all industrial, hydraulic, municipal, structural, electrical, mechanical, mining and other works which require experience and the same technical knowledge as engineering schools of recognized reputation prescribe for graduation."

Your committee recommends that all such statutes should prescribe the following minimum requirements for a practitioner of civil engineering: (1) He shall be not less than 25 years of age; (2) he shall be of good moral character; (3) he shall have been engaged actively in civil engineering work, as an assistant to a licensed practitioner, for at least six years, and as such shall have had responsible charge of engineering work for at least one year; (4) for a graduate from a school of engineering of recognized reputation, the term of actual engagement as an assistant shall be four years.

The foregoing are the minimum requirements for corporate membership in the American Society of Civil Engineers, and there should be inserted in any law a clause to the effect that the certificate of corporate membership in this society entitles its holder to practice as a civil engineer without examination.

All state laws should also be uniform in their provision for the necessary examination of candidates for admission to practice, and your committee suggests that such examinations be conducted by a board of five civil engineers, appointed by the Governor of the state, and serving without compensation other than actual expenses; each of these shall be not less than 30 years of age, and shall have been in active practice for not less than ten years. The board to conduct examinations not less than three times each year at different places in the state; to prepare all examination papers; rate each candidate and certify to said rating to the proper authoritative body, which shall thereupon issue licenses. The fee for the issue of a certificate giving the right to practice should not exceed $25.

All laws should make it unlawful for anyone unlicensed to accept engagement as a civil engineer, and no unlicensed person should be allowed to sue any court of the state for compensation for services rendered, or to qualify as an expert witness before any state or municipal court. The license to practice in one state should be made effective in other states so that civil engineers who are licensed to practice in any state or territory shall have the right to practice in any other state without examination.

If laws are passed in all states upon the basis above outlined, it does not appear that there can be any valid objection from properly qualified civil engineers. The enactment of such laws would result in placing the profession upon a better basis, and would, in some measure at least, protect the public from incompetent and irresponsible practitioners.

Your committee recommends that the Board of Direction be empowered to take up this matter with the proper authorities from time to time as may be deemed expedient, and to urge the enactment of state laws in general conformity with the suggestions of this report; and further, that the Board appoint from the membership committee of three in each state to cooperate with the Board and to act under its direction.

The Need for Collective Effort by Engineers.*

By JOHN A. BENSEL, Pres. Am. Soc. C. E.

I know that to some of my audience a satisfactory address at a summer convention would be like that which many people regard as a satisfactory sermon—something soothing and convincing, to the effect that you are not as other men are, but better. While I appreciate very fully, however, the honor of being able to address you, I am going to look trouble in the face in an effort to convince you that in spite of great individual achievements, engineers are behind other professional men in professional spirit, and particularly in collective effort.

Whether this, if true, is due to our extreme youth as a profession, or our extreme age, is dependent upon the point of view; but I think it is a fact that will be admitted by all that engineers have not as yet done much for their profession, even if they have done considerable for the world at large.

Looking backward, our calling may properly be considered the oldest in the world. It is older, in fact, than history itself, for man did not begin to separate from the main part of animal creation until he began to direct the sources of power in nature for the benefit, if not always for the improvement, of his particular kind. In Bible history, we find early mention made of the first builder of a pontoon. This creditable performance is especially noted, and the name of the party principally concerned prominently mentioned. The same thing cannot be said of the unsuccessful attempt at the building of the first sky scraper, for here the architect with unusual modesty has not given history his name, his omission being possibly due to the fact that the building was unsuccessful. If an engineer was employed on this particular undertaking, the architect had, even at that early stage of his profession, learned the lesson of keeping all except his own end of the work in the background.

The distinctive naming of our profession does not seem, however, to go back any further than the period of 1761, when that father of the profession, John Smeaton, first made use of the term of engineer, and later, civil engineer, applying it both to others and to himself, as descriptive of a certain class of men working along professional lines now existing and described by that term.

Remarkable progress has certainly been made in actual achievements since that time, and I know of nothing more impressive than to contemplate the tremendous changes that have been made in the material world by the achievements of engineers, particularly in the last hundred years. This was forcibly impressed upon me a short time since, while in company of the late Mr. Charles Haswell, the oldest member of the society, who, seeing one of the recently built men-of-war coming up the harbor, remarked that he had designed the first steamship for the United States Navy. The evolution of this intricate mass of mechanism, which, from the very beginning of its departure from the sailing type of vessel, has taken place entirely within the working period of one man's life, is as graphic a showing of engineering activity as I think can be found.

Our activities are forcibly shown in many other lines of invention and in the utilization of the forces of nature, particularly in the development of this country. We, although young in years, have become the greatest railroad builders in history, and have put into use mechanical machines like the harvester, the sewing machine, telephone, wireless telegraph, and almost numberless applications of electricity. Ships have been built of late years greatly departing from those immediately preceding them, so that at the present time they might be compared to floating cities with nearly all a city's conveniences and comforts. We have done away with the former isolation of the largest city in the country, and have made it a part of the main land by the building of tunnels and bridges. In all our work it might be said that we are hastening with feverish energy, from one problem to another, for the so-called purpose of saving time, or for the enjoyment of some new sensation; and we have also made possible the creation of that which might be deemed of doubtful benefit to the human race, that huge conglomerate, the modern city. There has been no hesitancy in grappling with the problem of nature by engineers, but they seem to be diffident and neglectful of human nature in their calculations, leaving it out of their equations, greatly to their own detriment and the world's loss. We can say that matters outside of the known are not our concern, and we can look with pride at our individual achievements, and of course, if this satisfies, there is nothing more to be said; but it is because I feel that engineers of to-day are not satisfied with their position, that I wonder whether we have either fulfilled our obligations to the community, or secured proper recognization from it; whether, in fact, the engineer can become the force that he should be, until he brings something into his equations besides frozen figures, however diverting an occupation this may be. One may wonder whether this state of affairs is caused from a fear of injecting uncertain elements into our calculations, or whether it is our education or training which makes us conservative to the point of operating to our own disadvantage. We may read the requirements of our membership and learn from them that in our accomplishments we are not to be measured as skilled artisans, but the fact remains that, to a great extent, society at large does so rate us, and it would seem that we must ourselves be responsible for this state of affairs.

Our colleges and technical schools are partly to blame for the existence of this idea, on account of the different degrees which they give. We have a degree of civil engineer, regarded in the narrowest sense, of mining engineer, mechanical engineer, electrical engineer, and by necessity it would seem as if we should shortly add some particular title to designate the engineer who flies. In reality there should be but two classes of engineers and the distinction should be drawn only between civil engineers and military engineers. As a matter of fact, fate and inclination determine the specialty that a man takes up after his preliminary training, and so far as the degrees are concerned, the only one that has any right to carry weight, because it is a measure of accomplishment, is that which is granted by the society to its corporate members. The schools, in their general mix-up of titles, certainly befog the public mind. It is as if the medical schools, for instance, should issue degrees at graduation for brain doctors, stomach doctors, eye and ear doctors, etc. Very wisely, it seems to me, the medical profession and the legal profession with a far older history than ours, and with as wide variation in practice as we have, leave the variations in name to the individual taste of the practitioner in a manner which we would do well to copy. The society itself has adopted very broad lines in admission to membership, classing as civil engineers all who are properly such; and there is good reason for the serious consideration of the term at this time as we cannot fail to recognize a tendency in state and other governments to legislate as to the right to practice engineering.

As to the manner in which engineers individually perform their work, no criticism would properly lie, and in fact it is fortunate that our work speaks for itself, for, as a body, we say nothing. We are no longer, however, found working for the greater part of the time on the outskirts of civilization, and it becomes necessary, therefore, for us to change with changing conditions, and to use our society not only for the benefit of the profession as a whole, but for the benefit of the members individually. Whether one of our first steps in this direction should be along legislative lines is for you to determine. For myself, having been confronted with legislation recently attempted in New York, I am convinced that we shall have legislation affecting our members, and this legislation should properly be molded by some responsible body like our own society. If we do not take the matter up ourselves it is likely to be taken up by other associations, and from past experience, it would seem as though it might be carried on along lines that would tend to ridicule our desire for professional standing.

In these days when the statement that two and two make four is accepted as a newly discovered truth from its latest originator, a little extension of our mathematics to take into our estimate people as well as things, is what we principally need, and it would be a good thing regarded either from the point of view of what the world needs or the more selfish view of our own particular gains. At the present time it would seem as though our world had thrown away the old gods without taking hold of any new ones. Private ownership as it formerly existed is no longer recognized; individual action in almost any large field is to-day hampered and curtailed in a manner undreamed of 20 years ago. In fact, our whole scheme of government seems to be passing from the representative form on which it was founded, to some new form as yet undetermined. Whether all this is, in our opinion, for good or for evil is of no particular concern. The matter that concerns us is, that we have left our old moorings and that to secure new ones new limits are to be set to the activities of men along lines which concern us, and that, therefore, it is necessary that those who by education and training are best fitted to consider facts and not desires, should guide society as much as possible along its new lines. I consider that we as a profession are particularly trained to do this by our consideration of facts as they exist, and I think it will be recognized by all that we are not in our work or activities bound by any precedent, even if we do learn all that we can from the past; and that we are by nature and training of a cool and calculating disposition, which is surely a thing that is needed in this time of many suggested experiments.

To be effective, however, we must be cohesive, and thus be able to take our part not as the led, but as leaders, convincing the people, if possible, that all the ills of our social system cannot be cured by remedies which neglect the forces of creation, and that the best doctors for our troubles are not necessarily those whose sympathies are most audibly expressed.

*Slightly condensed from the Presidential Address at the 42d Annual Convention of the American Society of Civil Engineers, Chicago, Ill., June 21, 1910.

Work of the Smoke Inspection Bureau at Milwaukee, Wis.*

As the strict enforcement of the smoke ordinance would have meant a hardship to manufacturers in the beginning, the Board for Suppression of Smoke was created to permit manufacturers to appear before the board (when served with notice) to state cause for not being able to comply with the ordinance in the time specified. The board in its judgment would extend the time if the excuse was found reasonable. Many had just installed plants at a great cost, and to force them to rebuild the same at once would not appear justified. Thousands of dollars have been spent since to equip steam power plants with the best furnaces that engineers have designed both for economy and smoke prevention, the latter naturally following in a correctly designed furnace.

All steam power plants in the city are on record in the office of the Smoke Inspector, with the horse-power, height and size of chimneys and stacks, kind of furnace, class of boiler and grade of coal used. The collecting of these records was a tedious job, as manufacturers were not favorably inclined towards the movement and hampered this work considerably. The time required for this purpose was about one year. This department requires a permit for the installation of furnaces, and will only issue the same where conditions warrant a smokeless operation with the furnace to be installed.

The river traffic is still a difficult proposition. Owing to the six minutes per hour allowed by the ordinance,

*From the annual report of Mr. Charles Poetsch, Smoke Inspector, Milwaukee, Wis. The Board for the Suppression of Smoke is composed of the City Engineer, Chief Engineer of Water-Works, Chief of Police, Chief Inspector of Buildings, and the Commissioner of Health.

boats cannot be followed and charts and pictures taken. In the summer we receive numerous complaints. The only solution to remedy this nuisance would be to station an inspector on the roof of some high building along the river, enabling him to take observations. We are at present only able to get evidence when boats are docked and remain stationary. This also holds true with locomotives, where conditions are practically the same. The Chicago, Milwaukee & St. Paul Ry. and the Chicago & Northwestern Ry. are using every effort to comply with the ordinance and each has a smoke inspector looking after the engine crews.*

The first ordinance has undergone several changes to make the law more stringent and improve upon its weak points, as was found necessary from time to time. The court has been very lenient with offenders in the past; it felt somewhat skeptical in enforcing the law, believing, as many do to-day, that smoke was unavoidable.

The ordinance as amended has stood the test in court, having been dissected by attorneys in various smoke cases. It also stood the test before a jury instructed to pass upon a verdict on the following points: (1) is the smoke ordinance reasonable; (2) is smoke a nuisance; (3) was a violation committed upon testimony produced. All three points were decided in favor of the city. Not one smoke case has been lost since photographs are taken in connection with our regular charts. Formerly violators of the ordinance absolutely denied being guilty, but being confronted with this silent witness they now ask for leniency, with the promise of behaving in the future. It is also gratifying to note that since the fine has been increased the court has imposed the minimum of $25 upon all violators, with the exception of one case, when a shipment of wrong coal was claimed by the defense.

There always will be a certain pall of smoke over a manufacturing city where soft or bituminous coal is used and a limited time to smoke is allowed. It is not the intent of the ordinance to prevent all smoke, which cannot be done under present conditions, but to secure a reasonable operation of furnaces. There is no question that with the proper boiler setting, adequate height of chimneys and proper furnaces or stokers, adapted for their various demands, dense smoke can be eliminated; in fact an absolutely clear chimney top is obtained with some of them. If the manufacturer or owner would but realize that abatement of the smoke nuisance means economy in operation, a decrease in consumption of coal and at the same time does away with a nuisance which is dangerous to health and property, he would not hesitate to take immediate steps to better his condition.

Very frequently the increase in capacity of manufacturing plants has not been accompanied by a corresponding increase in their boiler capacity, and in order to obtain the required duty, furnaces are forced to an extent which makes it impossible for the men in charge to comply with the ordinance. Lack of room for more or larger boilers in such plants is often due to faulty architectural designs and we also find them placed in more or less inaccessible positions instead of roomy, well ventilated quarters, so that the firemen spend as little time as possible in the boiler-room and hasten out to get fresh air.

PROTECTION AGAINST MINE CAVE-INS which are disturbing the surface at Scranton, Pa., has been undertaken by a joint committee of City Council, School Board and Board of Trade. An advisory board of engineers, composed of John Hays Hammond, Past President, Am. Inst. M. E.; W. A. Lathrop, L. B. Stillwell, President, Am. Inst. E. E.; D. W. Brunton, President Am. Inst. M. E., and R. A. F. Penrose, has offered to serve without compensation. Mr. E. T. Connor, M. Am. Inst. M. E., of Philadelphia, and Mr. Wm. Griffith, of Scranton, have been proposed as engineers for the immediate investigation of conditions and the application of remedies. It is expected that about four months will be consumed in the investigation.

THE 11,000-VOLT RAILWAY CURRENT on the New York, New Haven & Hartford R. R. killed a fireman of a Boston freight train at New Rochelle on June 26. It is reported that he dropped a slice bar off the tender and as the train was proceeding at a slow speed, jumped off, picked up the bar and climbed on board a freight car with it. As he was passing along the top, returning to his engine, the bar swung up against the overhead line. It happened that he was near or on a brake wheel and a short circuit through his body resulted. He was knocked from the car under the wheels and the body was mutilated, though probably death was instantaneous at the time of electrical contact.

THE FIRST AERIAL LINER "Deutschland," on June 22, made its maiden voyage from Friedrichshafen, on Lake Constance, Germany, to Düsseldorf, passing through the valleys of the Main and Rhone. The whole distance of 250 miles was covered in nine hours, including stops at Mannheim and Stuttgart. The "Deutschland" will make trips about Düsseldorf as often as the traffic warrants. A fare of $50 will be charged, it is reported, for a three-hour trip. The airship is of the regular Zeppelin type, 485 ft. long and 46 ft. wide. It has a gas capacity of 24,852 cu. yds., giving it a gross lifting power of 44,000 lbs., of which an allowance of 11,000 lbs. is made for crew, passengers, baggage supplies, etc. There are three motors having a total capacity of 330 HP. Between the end gondolas, suspended from the balloon frame, is a car, much like the body of an American Pullman, for the passengers. Here also buffet meals are served. The subsequent wreck of the airship is noted on the following page.

TYPHOID FEVER AT MILWAUKEE, WIS., has caused much anxiety of late, and is attributed by Dr. W. C. Rucker, Health Officer, to the water-supply. A temporary hypochlorite water-disinfecting plant has been installed, it is reported. The City Council has adopted a resolution requesting Messrs. John W. Alvord, of Chicago; Harrison P. Eddy, of Boston, and George C. Whipple, of New York, to hasten their report on sewage disposal. The water-supply of Milwaukee is taken from Lake Michigan at a depth of 60 ft. from the surface and at a distance of about 1½ miles from the shore (Eng. News, Sept. 19, 1895). The sewage of the city is discharged into the lake; some direct by means of an intercepting sewer and pumping station, and some by way of rivers which flow through the city.

MUNICIPAL OWNERSHIP OF WATER-WORKS AT Denver, Colo., is much to the front and will probably continue to be so for some time to come. The Denver Union Water Co. has rejected the offer of $7,000,000 for its plant made by the new Public Utilities Commission in accordance with a charter amendment adopted at a recent city election. The property of the company named was appraised at $14,400,000 not long ago by four of the five members of a commission of engineers appointed to place a valuation upon the plant. The price was deemed excessive by many of the citizens of Denver, and in creating the Public Utilities Commission named above, provision was made for offering the company $7,000,000 for its property. Further provision was also made for building an independent plant at municipal expense, in case the company rejected the offer. For this purpose, a bond issue of $8,000,000 was authorized. The Denver Union Water Co. is reported as having some $11,000,000 of outstanding stock and bonds.

WIRELESS TELEGRAPH equipment of all vessels sailing from American ports is demanded before July 1, 1911, by a bill passed by the House of Representatives on June 20. A similar bill had previously passed the Senate. A bill to regulate wireless telegraph operation, in order to prevent interference with government and important messages, also passed the Senate.

STEEL PASSENGER CARS are being used very extensively on the Pennsylvania Ry. System. According to a statement issued by this railway it has nearly 2,000 passenger cars of all-steel construction in service or ordered. These cars have been added to the railway's equipment since June 1, 1906, when it was announced that future additions to passenger equipment on the entire Pennsylvania System would be of all-steel construction. The designs for these cars were illustrated and described in our issue of June 20, 1907, and those of several other railways in our issue of Sept. 3, 1908.

The Pullman Co. is constructing a sufficient number of steel sleeping and parlor cars to equip the entire Pennsylvania System, and these cars are being delivered at the rate of 50 to 60 per month. Already there are in service on through trains 75 sleepers and five combined parlor and baggage cars. When the present order is completed there will be in service some 600 all-steel Pullman cars; this number is included in the 1,988 cars now in use or on order. The steel passenger cars weigh some 118,500 lbs. as against 85,000 lbs. in the standard vestibule wooden coach. This increase in weight very greatly reduces the vibration of the car, thereby adding to the comfort of passengers. The car is noncollapsible, its principal feature being a central box girder 24 ins. wide and 19 ins. deep extending throughout the entire length of the coach. This girder is designed to prevent telescoping in case of collision. The car is fireproof, containing only about 125 lbs. of wood; which is used for window frames and arm rests in the seats.

In the steel equipment now in service, there are 457 coaches, 22 dining cars, 34 passenger and baggage cars, 33 baggage cars, 78 postal and 80 Pullman cars. In addition to these there are on order or under construction at the present time, 502 steel coaches, 28 steel dining cars, 83 passenger and baggage cars, 83 baggage, 39 postal, 28 baggage and mail, 1 combination motor car, and some 520 Pullman cars. With the 704 steel cars in use at present, and the 1,284 cars on order, the Pennsylvania System will shortly have a total of 1,988 steel passenger equipment cars.

CONCRETE ROOFING SLABS are used for covering the arched trainshed of the La Salle Station, Chicago, and some repair work on this roof is now being carried out, being made necessary by the action of gases from the locomotives upon the concrete, which had not been given any preservative or protective treatment. The trainshed was described in our issue of Aug. 6, 1903. The slabs are 2 × 5 ft., 2½ ins. thick; weighing about 225 lbs. each. The original slabs are reinforced by expanded metal, but wire netting is being used in the present work. They have tongued-and-grooved edges, and countersunk holes for the bolts attaching them to the steel framing. The new slabs are given a special treatment to make them waterproof and gas resisting. They are made in groups on a platform with removable strips to form the sides of the molds. The concrete is a 1:2:4 mixture, made fairly wet, and the top surface is troweled to a smooth surface. After 24 hours the side pieces are removed, and in a few days (according to the weather) the slabs are taken to the storage yard, where they are stacked for curing, being kept damp for about five days. They are then ready for the preservative treatment. The slab is first thoroughly cleaned with water, and is then coated with a solution of a patented material termed "Ironite," which is brushed over the entire surface. The material is a very fine mineral powder which is mixed with water for use, making a solution about the consistency of whitewash. This is absorbed by the concrete, filling all the pores. After two days a second coating is applied, and when this has dried the slab is ready for use. The mortar joints on the roof are treated in the same way. The material is manufactured by the Ironite Co., of Chicago. The work is being done by the Geo. B. Swift Co., of Chicago, under the direction of Mr. A. T. Hawk, Architect for the Rock Island lines.

AN OPEN-AIR SWIMMING POOL at Denver, Colo., with provision for warming the water, was opened in Lincoln Park, on the west side of the city, early in June, 1910. The provision of a heating plant for an open-air swimming pool for summer use is thus explained by Denver "Municipal Facts," the official city weekly:

As Denver's water-supply comes from the snow-capped mountains it is uncomfortably cool for bathing, and next to impossible for swimmers, hence it was necessary that the pool be warmed to a certain temperature.

The swimming pool is 40 × 100 ft. in plan. At one end of it a concrete building houses dressing-rooms, shower-baths, etc., together with the heating plant and the office of the superintendent.

THE USE OF HYPOCHLORITE OF LIME, or bleaching-powder, at Seymour, Ind., is briefly described by Mr. J. H. Brewster in the "Proceedings" of the annual convention of the Indiana Sanitary & Water Supply Association, held Feb. 25, 1910, as follows:

I had an experience at the city of Seymour. I was called down there some time ago, to look into the condition of their water-supply, which was not entirely satisfactory. The water was at all times turbid and the bacterial count was exceedingly high. At that time they were using alum as a coagulant, about 2½ grains per gal., and the water after it had been filtered contained about 1,200 bacteria per c.c. We increased the amount of coagulant until we reached 10 grains per gal. At this time we found we still had 500 or 600 bacteria per c.c. in the water with colon bacillus present. We could not keep on increasing the quantity of alum on account of the cost, so we decided to use a sterilizing agent of some kind, and for this purpose we used hypochlorites, or bleach. To do this, we built a little plant consisting of two galvanized iron tanks, the entire cost of which was about $30. This includes tanks and the taps and everything that goes with it. We used about 6 lbs. of bleaching-powder per 1,000,000 gals. It cost about 15 cts. With this amount of bleach we obtained practically sterile results. The superintendent of that plant has furnished me with daily reports from the first of January to the present time, and we find that through January about half the days gave sterile water, the rest of the time the bacteria ran from 1 to 20 per c.c. During the month of February, two days there were bacteria found, one day 20 and one day 1. The reason for using bleach in this case was because of the peculiar construction of the plant; the sedimentation basin was made entirely too small, so the increase of alum did nothing but load down the beds and increase the washing. After we used the bleach we cut the alum down to the original amount and obtained just as satisfactory water and reduced the cost of washing and operation very materially. This simply shows what hypochlorite of lime will do as an adjunct to filtration.

From the same general source of information we learn that hypochlorites have been used at Danville, Ill., first as a substitute for iron and lime and later in combination with those chemicals. About 0.1-grain per gal. of hypochlorites was used, at a cost of 28 cts. per 1,000,000 gals. of water.

THE TURN-OVER MECHANICAL FILTER is a new device which differs from other filters in the way by which it is cleaned. This filter is constructed in the form of a metal cylinder in various sizes from 3½ to 8 ft. in diameter and 1½ to 12 ft. long. The cylinder is mounted with its axis horizontal, and the filtering medium occupies its lower half. Water is admitted to the space above the filtering material, passes down through into a chamber at the bottom, separated from

*The report shows that in 1909 the inspector of the C., M. & St. P. Ry. reprimanded 37 men, and 12 men were discharged. On the C. & N. W. Ry. 115 men were reprimanded and 15 discharged.—Ed.

the material above by a flat screen, and is conducted thence to the outlet.

The inlet and outlet pipes are brought through the end walls of the cylinder at its axis so that they form trunnions about which it can be turned. When it is desired to clean the filter, the cylinder is rotated about these trunnions which, of course, remain stationary. The filtering material during rotation is repeatedly carried up the sides and dropped down again through the water, so that both the filter walls and the sand or gravel itself are well scoured and cleaned. During the cleaning process the flow of water is reversed, entering through the screen and emerging through what was the inlet pipe in normal operation, but which is now connected to a drain. The weight of the filter is carried on rollers, in the same way as a cement kiln or cylindrical mine screen, thus relieving the trunnions, and it is rotated by means of a pinion meshing with a toothed ring carried by the cylinder.

The filtering material used is crushed quartz. This material is claimed to give better results than ordinary sand because its particles are sharper and act more effectively in scouring both each other and the filter walls during the cleaning operation.

As a preliminary treatment for the water passed through the filter, the makers, the Turn-Over Filter Co., 39 Chichester St., Belfast, Ireland, recommend, in general, primary coagulation with sulphate of alumina and lime-water. A special dosing apparatus has been devised in which the reagents are injected through nozzles. This treatment has been used with success, in conjunction with the filters, for purifying the water in swimming pools.

An illustrated description of this filter was published in the London "Engineering," June 10, 1910.

IN SIGNING THE RIVER AND HARBOR BILL President Taft affixed a memorandum serving notice that he would not be likely to approve another River and Harbor Bill made up of appropriations for doing the work piecemeal. The present bill carries appropriations for $52,000,000.

A 1,000-TON SAND BIN COLLAPSED June 23 near Mineola, L. I., at the plant of the Phoenix Towing & Transportation Co. Twelve carpenters were at work on top of the bin and some of them fell in such a way as to be buried in the sand. Two of the men were killed and a half dozen others were injured. A locomotive and some cars which were under the bin when it gave way were completely buried.

A BOILER EXPLODED June 22 at the plant of the Vinegar Bend Lumber Co., Vinegar Bend, Ala. Two men were killed and the damage to property is estimated at $25,000.

A POWDER MILL EXPLOSION at Valley Falls, Rensselaer Co., N. Y., June 24, destroyed the press and corning mills of the Du Pont company's plant and killed three men.

FOREST FIRES IN ONTARIO last week destroyed an immense tract of timber including an area of about 1,700 sq. mi. near Atikokan, Ont., belonging to the F. Wayerhauser Co., or St. Paul, Minn.

A MEXICAN TROOP TRAIN was wrecked June 23 on the Manzanillo line of the National Rys. in the state of Colima. Four cars broke away from the locomotive during the ascent of a steep grade and attained such a speed down grade that they left the track. There were about 150 men in the four cars and reports state that more than 60 were killed.

THE ZEPPELIN AIRSHIP "DEUTSCHLAND" was wrecked in a heavy gale June 28 against treetops in the Teutoburgian forest near Osnabrück, Germany. The "Deutschland" sailed from Düsseldorf at 8.30 a. m. with about 30 persons on board. It was planned to fly to Dortmund, a distance of about 35 miles, but a strong head wind made this trip too difficult. One of the engines stopped and could not be restarted for some time, and meanwhile the violence of the gale increased so much as to endanger the safety of the balloon. After a prolonged struggle with the storm, the airship, with one engine again disabled, was dragged by the wind across the dense Teutoburgian forest and finally, at 5.30 p. m., was caught in the branches. All those on board escaped unharmed to the ground by means of a rope ladder. The frames were broken and the silk covering of the balloon was badly torn, but the engines were not damaged. The "Deutschland" had been sold shortly before the trip to a German airship company for the sum of $137,500.

Personals.

Mr. H. H. Westinghouse, M. Am. Soc. M. E., has become President of Westinghouse, Church, Kerr & Co., of New York City, succeeding the late Walter C. Kerr.

Mr. Rossiter R. Potter, of the editorial staff of Engineering News, was married to Miss Harriet Emma Goodrich, of Detroit, Mich., on June 24 at the home of the bride.

Mr. S. F. Crecelius, M. Am. Soc. C. E., has resigned his position as a U. S. Assistant Engineer and has opened an office for the practice of civil engineering at 408 Equitable Bldg., Louisville, Ky.

Mr. P. B. Breneman, Assoc. Am. Soc. C. E., Associate Professor of Mechanics and Materials of Construction at the Pennsylvania State College, in charge of the department, has been made a full professor.

Mr. Edmund T. Perkins, M. Am. Soc. C. E., Engineer in Charge, U. S. Reclamation Service, of Chicago, Ill., is to retire from that position Aug. 1 to become the head of the Edmund T. Perkins Engineering Co.

Mr. Wm. Gerig, M. Am. Soc. C. E., recently Second Vice-President and Chief Engineer of the Pacific & Eastern Ry., at Medford, Ore., has been made Vice-President, General Manager and Chief Engineer of the same railway.

Col. Walter L. Fisk, Corps of Engineers, U. S. Army, has been appointed to succeed Brig.-Gen. W. H. Bixby, Chief of Engineers, as President of the Mississippi River Commission, with headquarters at St. Louis, Mo. Col. Fisk is at present Division Engineer of the Lakes Division at Buffalo, N. Y. It is expected that he will remain in Buffalo in his present position until autumn.

Mr. C. C. F. Bent, M. Am. Soc. C. E., will retire from his position as General Manager of the Baltimore & Ohio Southwestern R. R., at Cincinnati, Ohio, in order to become General Superintendent of the Baltimore & Ohio R. R. at New York City, in charge of terminals, succeeding Mr. O. H. Campbell. The duties of his former position at Cincinnati have been assigned to Mr. W. H. Brimson, General Superintendent of the Baltimore & Ohio Southwestern.

Mr. Arthur H. Blanchard, M. Am. Soc. C. E., Associate Professor of Civil Engineering at Brown University, has recently resigned his position as Deputy Engineer of the State Board of Public Roads of Rhode Island. Professor Blanchard, who is now in Europe, will remain abroad until after the sessions of the International Road Congress, at Brussels during the first week of August, and will continue his investigations of the construction and maintenance of bituminous surfaces and bituminous pavements, which he has been conducting abroad for some months past.

Mr. Thomas H. Means, M. Am. Soc. C. E., and Mr. Leslie W. Symmes have entered into partnership under the firm name of Symmes & Means, as agricultural engineers, with offices in the Balboa Bldg., San Francisco, Cal. Mr. Symmes, who is a graduate of the University of California, has been engaged in agricultural engineering for the past four years and was formerly in the U. S. Forest Service and U. S. Reclamation Service. Mr. Means has served nine years with the Department of Agriculture and six with the Reclamation Service. For the last 2½ years he was Project Engineer of the Truckee Carson project in Nevada.

Obituary.

Francis M. Ferguson, President of the Ferguson Contracting Co., railway contractors, died at Denver, June 22. A notice of his life will be given later.

Guy R. Johnson, M. Am. Inst. M. E., formerly Vice-President and General Manager of the Alabama Consolidated Coal & Iron Co., shot himself June 22 and died the following day at his home in Birmingham, Ala. His suicide is ascribed to business reverses.

William H. Brown, formerly Chief Engineer of the Pennsylvania R. R., suffered an attack of heart disease while walking on the street in Belfast, Ireland, June 25, and died soon after reaching his hotel. Mr. Brown was born Feb. 29, 1836, at Lancaster, Pa. He first entered railway service in 1861 as an engineer on the U. S. Military R. R. In the following year he became Assistant Engineer of the Pittsburgh, Cincinnati, Chicago & St. Louis Ry. and was promoted to be Principal Assistant Engineer in 1863. He entered the employ of the Pennsylvania R. R. in 1864 as Assistant Engineer on the Pittsburg division. In 1867 he became Engineer of the Philadelphia & Erie division, and in 1869 he was put in charge of construction of the Altoona Car Shops, with the title of Assistant Engineer. He was subsequently appointed Resident Engineer of the middle division in 1870, Chief Engineer and Superintendent of the Lewistown division in 1871, Superintendent of the Bedford division in 1872, and in 1874 he became Engineer of Maintenance of Way of the Pennsylvania R. R. He served in this position until, in 1881, he was made Chief Engineer of the Pennsylvania R. R. He retired from this position March 1, 1906. A fuller account of Mr. Brown's life work will be given in a forthcoming issue.

Engineering Societies.

COMING MEETINGS.

CANADIAN ELECTRICAL ASSOCIATION.
July 6-8. Annual convention at Lake Rosseau, Ontario. Secy., T. S. Young, Toronto, Ont.

AMERICAN CHEMICAL SOCIETY.
July 12-16. Annual meeting at San Francisco, Cal. Secy., Charles L. Parsons, Durham, N. H.

OHIO ELECTRIC LIGHT ASSOCIATION.
July 26-28. Annual convention at Cedar Point, Ohio. Secy., D. L. Gaskill, Greenville, Ohio.

TRAVELING ENGINEERS' ASSOCIATION.
Aug. 16-19. Annual convention at Niagara Falls, Canada. Secy., W. O. Thompson, New York Central Car Shops, East Buffalo, N. Y.

LEAGUE OF AMERICAN MUNICIPALITIES.
Aug. 23-26. Annual convention at St. Paul, Minn. Secy., John MacVicar, Des Moines, Iowa.

AMERICAN PUBLIC HEALTH ASSOCIATION.
Sept. 5-9. Annual meeting at Milwaukee, Wis. Secy., W. C. Woodward, Washington, D. C.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES.
Sept. 6-8. Annual meeting at Thousand Islands, N. Y. Asst. Secy., Walter Neumuller, 55 Duane St., New York City.

CANADIAN ELECTRICAL ASSOCIATION.—At the 20th annual convention at Lake Rosseau, Ont., July 6-8, the convention headquarters will be at the Royal Muskoka Hotel. Among the papers to be presented are the following: "Protection of Service in Large Electric Systems," A. S. Loizeaux, Baltimore, Md.; "Notes on Transmission Line Regulation," Paul M. Lincoln, Pittsburg, Pa.; "Tungsten Street Lighting with Special Reference to 25-Cycle Circuits," C. L. Stephens, Pittsburg, Pa.; "The Diesel Oil Engine," F. A. Yerbury, Toronto, Ont. A number of special committee reports will be presented, including those of the committees on standardization of line construction; grounding of transformer secondaries; installation, care and testing of meters; and conservation of natural resources.

OHIO ELECTRIC LIGHT ASSOCIATION.—Papers to be presented at the 16th annual convention at Cedar Point, Ohio, July 26-28, are as follows: "Experience with Series Tungsten Lamps for Street Lighting," Claude C. Smith, Bradford, Ohio, C. C. Custer, Piqua, Ohio, and Frank Jackley, Eaton, Ohio; "Progress Made in the Introduction of Electric Vehicles in Ohio," J. T. Kermode, Cleveland, Ohio; "Turbine Troubles," Frank Brosius, Columbus, Ohio; "Outline of an Equitable Power Rate," B. H. Gardner, Dayton, Ohio; "Methods of Maintaining Electric Meter Accuracy," John Gilmartin, Toledo, Ohio; "Central Station Facts and Factors," J. R. Cravath, Chicago, Ill.; "Motors for Single Phase Circuits as They Are To-day," Prof. F. C. Caldwell, Ohio State University, Columbus, Ohio; "Low Pressure Turbines and Their Operation," W. C. Anderson, Canton, Ohio; "Methods to be Pursued in Getting New Business in Cities of 15,000 and Less," L. A. Petit, Jr., Middletown, Ohio; "Best Methods to be Followed in Purchasing Station Apparatus," R. J. Feathers, Columbus, Ohio; "Tungsten Lamps and Central Station Earnings," E. L. Booth, Bellaire, Ohio.

AMERICAN CHEMICAL SOCIETY.—At the annual meeting in San Francisco, Cal., July 12-16, a general session on July 13 will be followed by divisional sessions on July 14-16. Among the papers to be presented before the division of agricultural and food chemistry is one on "Extent and Composition of the Incrustation on Filter Sands," by Edward Bartow and C. E. Millar.

A symposium on smelter smoke will occupy the July 14 session of the division of industrial chemists and chemical engineers and will include the following papers: "Neutralization and Filtration of Smelter Smoke," W. C. Ebaugh; "Electrical Precipitation of Suspended Matter," F. G. Cottrell; "The Smoke Problem and the Community," Chas. Baskerville. On July 15-16, the papers presented will include the following: "The Scientific Use of Crude Petroleum As a Source of Power," Leon Labonde; "The Cuban Hedge Cactus; a Proposed Source of Crude Rubber," Chas. P. Fox; "Alloys of Nickel and Cobalt With the Metals of the Chromium Group," Elwood Haynes; "Factors Affecting the Electrolytic Method for the Determination of Copper in Ores," W. C. Blasdale; "Rust As An Accelerator in the Corrosion of Iron and Steel," W. D. Richardson; "Electrolytic Determination of Zinc in Ores," George Kemmerer; "Rapid Estimation of Available Calcium Oxide in Lime Used in Cyanide Work," L. W. Bahney.

Some of the papers to be presented before the division of physical and inorganic chemistry are as follows: "The Temperatures of the Carborundum Furnaces," Wilder D. Bancroft; "An Exact Electrolytic Method for Determining Some Metals," W. L. Perdue and G. A. Hulett; "A Common Thermometric Error in Determining Boiling Points Under Reduced Pressure," Alexander Smith; "A Convenient Form of Vapor Density Apparatus," Alan W. C. Menzies; "Comparative Analyses of Water From Great Salt Lake," Wallace MacFarlane; "A Reported Occurrence of Native Iron," W. C. Ebaugh; "Rapid Determination of Mercury, Silver, Bismuth and Copper by Means of Stationary Electrodes," R. C. Benner; "The Atomic Weight of Tantalum," Clarence W. Balke.